DOE/RL-2016-23
Revision 0

216-A-29 Ditch Interim Status Groundwater Quality Assessment Monitoring Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. Department of Energy Richland Operations Office

P.O. Box 550
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Revision 0

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216-A-29 Ditch Interim Status Groundwater Quality Assessment Monitoring Plan DOE-RL-2016-23, Revision 0 Certification

I certify that this monitoring plan meets the requirements in accordance with 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, "Ground-Water Monitoring," 265.93(d)(3)(i) through (iv).

1/26/2016

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Date

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Executive Summary

This document presents the groundwater quality assessment monitoring plan for the 216-A-29 Ditch and supersedes the 2010 interim status indicator parameter program groundwater monitoring plan[1]. This groundwater quality assessment monitoring plan is based on the requirements for interim status facilities, as defined by the *Resource Conservation and Recovery Act of 1976*[2] (RCRA) and the implementing requirements in WAC 173-303-400[3] which, in turn, specifies groundwater quality assessment monitoring regulations under 40 CFR 265.[4] This groundwater quality assessment program monitoring plan is the principal controlling document for conducting groundwater monitoring at the 216-A-29 Ditch.

Some content needed for this groundwater quality assessment plan has already been completed and is provided in a revision to the 2010 monitoring plan. The revision to the 2010 monitoring plan is provided in the revised indicator parameter evaluation plan.[5]
A crosswalk showing the information provided in DOE/RL-2008-58, Draft Rev. 1 that is pertinent to this groundwater quality assessment plan is provided.

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1 DOE/RL-2008-58, 2010, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084331.

2 *Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

3 WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-400.

4 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol25/xml/CFR-2010-title40-vol25-part265.xml.

5 DOE/RL-2008-58, 2015, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*, Draft Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0079138.

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Terms

bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
Ecology	Washington State Department of Ecology
RCRA	*Resource Conservation and Recovery Act of 1976*
WAC	*Washington Administrative Code*

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1 Introduction

This document presents the groundwater quality assessment monitoring plan (assessment plan) for the 216-A-29 Ditch and supersedes the 2010 interim status indicator parameter program groundwater monitoring plan, hereinafter called the 2010 monitoring plan (DOE/RL-2008-58, Rev. 0, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*). This assessment plan (DOE/RL-2016-23, Rev. 0) is based on the requirements for interim status facilities, as defined by the *Resource Conservation and Recovery Act of 1976* (RCRA), and the implementing requirements in WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards," which, in turn, specifies groundwater quality assessment monitoring regulations under 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." This assessment plan is the principal controlling document for conducting groundwater monitoring at the 216-A-29 Ditch.

In this assessment plan, several groundwater monitoring plans will be referenced. For simplicity sake, these plans will be referred to in the following manner:

- 2010 monitoring plan refers to DOE/RL-2008-58, Rev. 0, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*.
- Revised indicator parameter evaluation plan refers to DOE/RL-2008-58, Draft Rev. 1, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*.
- Assessment plan refers to DOE/RL-2016-23, Rev. 0, *216-A Ditch Interim Status Groundwater Quality Assessment Monitoring Plan*.

Data from wells monitoring the 216-A-29 Ditch indicate that the specific conductance measured in downgradient wells (299-E25-32P, 299-E25-35, and 299-E25-48) is statistically greater than the background established for the facility (16-ESQ-0032, "Notification of Ground Water Sampling Results Exceeding Specific Conductance for the 216-A-29 Ditch Monitoring Well Network in 2015 Per 40 CFR 265.93(2)(d)(1)"). This exceedance requires development of a groundwater quality assessment program in accordance with 40 CFR 265.93(d)(2), "Preparation, Evaluation, and Response." The plan for conducting the assessment includes performing those activates needed to determine whether a dangerous waste release has occurred from the facility. RCRA indicator parameter evaluation monitoring for the 216-A-29 Ditch was being performed under the 2010 monitoring plan. The 2010 monitoring plan was in the process of being revised in 2015 when the need for groundwater quality assessment arose. A revised indicator parameter evaluation plan had been provided to the Washington State Department of Ecology (Ecology) in December 2015. Some of the content needed for the groundwater quality assessment plan had already been completed and provided in the revised indicator parameter evaluation plan (DOE/RL2008 58, Draft Rev. 1) currently under Washington State Department of Ecology (Ecology) review. A crosswalk showing the information provided in the revised indicator parameter evaluation plan in comparison to the content to be presented within this assessment plan is provided in Table 1-1.

Elements of the 216-A-29 Ditch groundwater quality assessment program include:

- Description of the hydrogeologic conditions and identification of potential contaminant pathways (Sections 2.4 and 2.6 of DOE/RL-2008-58, Draft Rev. 1)
- Description of the investigative approach for making first determination to decide if dangerous waste or dangerous waste constituents from the facility have entered the groundwater or if the exceedance was caused by other sources (false positive rationale) (Section 4.1)

- Description of the approach to fully characterize rate and extent of contaminant migration (Section 4.1)
- Number, locations, and depths of wells in the monitoring network (Section 3.2)
- Sampling and analytical methods used (Appendix A, and Appendices A and B of DOE/RL-2008-58, Draft Rev. 1)
- Data evaluation methods (Appendix A of DOE/RL-2008-58, Draft Rev. 1)
- An implementation schedule (Chapter 5)

A first determination based on full implementation of this groundwater quality assessment will be made as soon as technically feasible. The first determination report of the findings will be sent to Ecology as required by 40 CFR 265.93(d)(5).

Assessment monitoring activities will start with utilization of the wells identified in the 2010 monitoring plan, since those wells are in the current network, with an addition of upgradient well 299-E25-2. If needed, assessment monitoring will be completed utilizing the updated well network identified in the revised indicator parameter evaluation plan (Table 3-2). Following installation of the three new wells identified in the revised indicator parameter evaluation plan, assessment sampling will continue using the updated well network if needed. This updated well network is configured to account for current groundwater flow conditions, contributions from upgradient sources, and is capable of detecting a releases from the site.

Currently, a determination has not been made if the specific conductance values measured in the three downgradient wells (299-E25-32P, 299-E25-35, and 299-E25-48) are related to a contaminant release from the 216-A-29 Ditch. The hydrogeologic and geochemical evaluation, conducted in conjunction with development of the revised indicator parameter evaluation plan, indicates that the well network configuration in the 2010 monitoring plan, is not properly aligned for the variation in groundwater flow direction along different portions of the ditch. Groundwater chemical analysis completed in 2015 has indicated that the contribution of sulfate and nitrate from upgradient sources have significantly affected the specific conductance levels in the three downgradient wells in which the exceedances have occurred.

One of the downgradient wells (299-E25-35) has had specific conductance exceedances as far back in 1990, which initiated the first assessment program for the 216-A-29 Ditch (WHC-SD-EN-AP-031, *Interim-Status Groundwater Quality Assessment Plan for the 216-A-29 Ditch*). Upon completion of that assessment program, it was shown that the specific conductance value was attributable to nonhazardous sulfate species in groundwater and not related to release of dangerous waste from the 216-A-29 Ditch (WHC-SD-EN-EV-032, *Results of Groundwater Quality Assessment Program at the 216-A-29 Ditch RCRA Facility*). As recognized in the hydrogeologic evaluation, most recently conducted and described in the revised indicator parameter evaluation plan, the configuration of the well network needs to have wells positioned both upgradient and downgradient of the facility based on the current groundwater flow conditions; measure the contribution of constituents in groundwater from known upgradient sources; and have sufficient downgradient wells to detect a release from the facility.

Based on review of the existing data, a sequence of actions is established in this assessment plan to use the current state of knowledge associated with the groundwater flow, waste site history, and existing data to determine if there are dangerous waste(s) or dangerous waste constituent(s) in the groundwater and their concentration. If dangerous waste(s) or dangerous waste constituent(s) are present, then additional actions are provided along with evaluation procedures for determining if the dangerous waste(s) or dangerous waste constituent(s) are associated with the 216-A-29 Ditch or some upgradient source.

Additional elements of this assessment program are provided in subsequent chapters, including the constituent list and sampling frequency, well network, data evaluation procedures, and implementation schedule.

Table 1-1. Crosswalk Showing Location of Content for this Groundwater Quality Assessment Monitoring Plan

Groundwater Monitoring Plan Elements	Where Information is Found	
	DOE/RL-2008-58, Draft Rev. 1, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*	**DOE/RL-2016-23, Rev. 0, *216-A-29Ditch Interim Status Groundwater Quality Assessment Monitoring Plan***
Introduction	--	Chapter 1
Background	Chapter 2	--
Facility Description and Operational History	Section 2.1	--
Regulatory Basis	Section 2.2	--
Waste Characteristics	Section 2.3	Table 2-1. *Known Hazardous Discharges to the 216-A-29 Ditch*, represented here. It is the same as Table 2.1 in DOE/RL-2008-58, Draft Rev. 1
Geology and Hydrogeology	Section 2.4	--
Summary of Previous Groundwater Monitoring and Results	Section 2.5	--
Conceptual Site Model	Section 2.6	--
Monitoring Objectives	--	Section 2.2
Groundwater Monitoring	--	Chapter 3
Constituent List and Sampling Frequency	--	Section 3.1
Well Network	--	Section 3.2
Data Evaluation and Reporting	--	Chapter 4
Evaluation of Dangerous Waste Constituents	--	Section 4.1
Interpretation	Section 4.3	--
Annual Determination of Monitoring Network	--	Section 4.2
Reporting and Notification	--	Section 4.3

Table 1-1. Crosswalk Showing Location of Content for this Groundwater Quality Assessment Monitoring Plan

Groundwater Monitoring Plan Elements	Where Information is Found	
	DOE/RL-2008-58, Draft Rev. 1, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*	**DOE/RL-2016-23, Rev. 0, *216-A-29Ditch Interim Status Groundwater Quality Assessment Monitoring Plan***
Implementation Schedule	--	Chapter 5
References	--	Chapter 6
Appendix – Quality Assessment Program Plan	Appendix A except for Tables A-3 through A-5	Appendix A for replacement tables only
Appendix – Sampling Protocol	Appendix B	--
Appendix – As Built Drawings of Wells in Well Network	--	Appendix B
Appendix – DOE/RL-2008-58, Draft Rev. 1	--	Appendix C

2 Background

2.1 Waste Characteristics

Known hazardous waste constituents discharged to the 216-A-29 Ditch are provided in Table 2-1.

Table 2-1. Known Hazardous Discharges to the 216-A-29 Ditch

Waste Constituent	Date	Description
Demineralizer Regenerant	1955 to February 1986	Characteristic (corrosive)
Aqueous Makeup Tank Heels and Off-Specification Batches	1955 to October 1984	Characteristic (corrosive and toxic)
N-Cell Prestart Testing (Oxalic Acid, Nitric Acid, Hydrogen Peroxide, and Calcium Nitrate)	April 11, 1983 to August 7, 1983	Characteristic (corrosive)
Potassium Permanganate and Sodium Carbonate Solution	October 19, 1983	CERCLA reportable release
Hydrazine Solution	June 6, 1984 September 13, 1984 to October 2, 1984	CERCLA reportable release
Potassium Hydroxide	December 2, 1984	CERCLA reportable release
Nitric Acid	August 22, 1984 January 18, 1985 May 27, 1985 June 25, 1985 October 28, 1985	CERCLA reportable release
Sodium Hydroxide	February 26, 1984 November 19, 1984 August 6, 1985	CERCLA reportable release
Cadmium Nitrate	May 16, 1984 December 18, 1985	CERCLA reportable release
Hydrazine	July 9, 1986	CERCLA reportable release

Note: Table 2-1 is the same as provided in DOE/RL-2008-58, Draft Rev. 1, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

2.2 Monitoring Objectives

The groundwater quality assessment monitoring program at the 216-A-29 Ditch is conducted with the objectives of providing a program capable of determining the rate and extext of migration and the concentration of dangerous waste from the 216-A-29 Ditch, if any, in the underlying groundwater, in accordance with applicable RCRA requirements for interim status treatment, storage, and disposal units. Regulatory requirements applicable to this assessment plan are found in WAC 173-303-400(3) and

40 CFR 265.90, "Applicability," through 265.94, "Recordkeeping and Reporting." Table 2-2 identifies where each groundwater monitoring element of the pertinent applicable regulations is addressed.

Table 2-2. Pertinent RCRA Interim Status Facility Groundwater Quality Assessment Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement[a]	Location Where Requirement is Addressed[b]
Number and Location of Wells	40 CFR 265.91, "Ground-Water Monitoring System": (a) A ground-water monitoring system must be capable of yielding ground-water samples for analysis and must consist of: (1) Monitoring wells (at least one) installed hydraulically upgradient (i.e., in the direction of increasing static head) from the limit of the waste management area. Their number, locations, and depths must be sufficient to yield ground-water samples that are: (i) Representative of background ground-water quality in the uppermost aquifer near the facility; and (ii) Not affected by the facility; and (2) Monitoring wells (at least three) installed hydraulically downgradient (i.e., in the direction of decreasing static head) at the limit of the waste management area. Their numbers, locations, and depths must ensure that they immediately detect any statistically significant amounts of dangerous waste or dangerous waste constituents that migrate from the waste management area to the uppermost aquifer.	Section 3.2
Well Configuration	40 CFR 265.91: (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. This casing must be screened or perforated, and packed with gravel or sand, where necessary, to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space (i.e., the space between the bore hole and well casing) above the sampling depth must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the ground water. Additional requirements from WAC 173-303-400(3)(c)(v)(C), "Dangerous Waste Regulations," "Interim Status Facility Standards": Ground water monitoring wells must be designed, constructed, and operated so as to prevent ground water contamination. Chapter 173-160 WAC may be used as guidance in the installation of wells.	Section 3.2 and Appendix C
Consitutents to be Sampled Frequency of Sampling Number, Location, Depth of Wells	-40 CFR 265.93, "Preparation, Evaluation, and Response" (d)(3) The plan to be submitted under §265.90(d)(1) or paragraph (d)(2) of this section must specify: (i) The number, location, and depth of wells; (ii) Sampling and analytical methods for those hazardous wastes or hazardous constituents in the facility; (iii) Evaluation procedures, including any use of previously-gathered groundwater quality information; and (iv) A schedule of implementation.	Sections 3.1 and 3.2

Table 2-2. Pertinent RCRA Interim Status Facility Groundwater Quality Assessment Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement[a]	Location Where Requirement is Addressed[b]
Methods Used to Evaluate the Collected Data and Responses	40 CFR 265.93 (d)(4) The owner or operator must implement the groundwater quality assessment plan which satisfies the requirements of paragraph (d)(3) of this section, and, at a minimum, determine: (i) The rate and extent of migration of the hazardous waste or hazardous waste constituents in the groundwater; and (ii) The concentrations of the hazardous waste or hazardous waste constituents in the groundwater.	Section 4.1 and DOE/RL-2008-58, Draft Rev. 1, Section 4.2
Recordkeeping and Reporting	40 CFR 265.93: (d)(5) The owner or operator must make his first determination under grargraph (d)(4) of this section, as soon as technically feasible, and prepare a report containing an assessment of groundwater quality. This report must be placed in the facility operating record and be maintained until closure of the facility. Additional requirements from WAC 173-303-400(3)(c)(v)(E), "Dangerous Waste Regulations," "Interim Status Facility Standards": A copy of the report must be submitted to the department within 15 days. 40 CFR 265.94, "Recordkeeping and Reporting": (b) If the groundwater is monitored to satisfy the requirements of §265.93(d)(4), the owner or operator must: (1) Keep records of the analyses and elevations specified in the plan, which satisfies the requirements of §265.9(d)(3) throughout the active life of the facility, and, for disposal facilities throughout the post-closure care period was well; and (2) Annually, until final closure of the facility, submit to the Regional Administrator a report containing the results of his or her groundwater quality assessment program which includes, but is not limited to, the calculated (or measured) rate of migration of hazardous water or hazardous waste constituent in the groundwater during the reporting period. This information must be submitted no later than March 1 following each calendar year.	Section 4.3 and Appendix A, and DOE/RL-2008-58, Draft Rev. 1 Appendix A, Section 3.9)

Notes: References cited in this table are included in Chapter 6 of this plan.

In accordance with WAC 173-303-400(3)(b), "Dangerous Waste Regulations," "Interim Status Facility Standards," for the purposes of applying the interim status standards of 40 CFR 265, Subpart F, "Ground-Water Monitoring," the federal terms "Regional Administrator" means the "Department" and "Hazardous" means "Dangerous".

a. RCRA regulatory requirements for interim status treatment, storage, and disposal units are found in WAC 173-303-400(3), "Dangerous Waste Regulations," "Interim Status Facility Standards," and 40 CFR 265.90, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Applicability," through 40 CFR 265.94, "Recordkeeping and Reporting," which are applicable to this groundwater monitoring plan.

b. Locations pertain to DOE/RL-2016-23 locations unless indicated otherwise.

RCRA = *Resource Conservation and Recovery Act of 1976*

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3 Groundwater Quality Assessment Monitoring

Dangerous waste constituents selected from Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100*, are used to determine if dangerous waste constituents from the 216-A-29 Ditch have impacted the groundwater.

3.1 Assessment Constituents List and Sampling Frequency

A list of dangerous waste constituents, from Appendix 5 of Ecology Publication No. 97-407 (except for pesticides, herbicides, and dioxins), is provided in Table 3-1. Supporting constituents and field parameters will be collected. Table 3-2 provides the full constituent list and sampling frequency for the assessment well network. Assessment constituents (Table 3-1) will be analyzed at the three downgradient wells (299-E25-32P, 299-E25-35, and 299-E2- 48) that exceeded the specific conductance critical mean and at two upgradient wells (299-E25-2 and 299-E26-13). Data from the upgradient wells will be used to determine if upgradient source(s) have contributed to the exceedances or any detected assessment constituent. Sampling for assessment constituents will be expanded to other wells in the 216-A-29 groundwater monitoring network if dangerous waste constituents are detected at the downgradient wells with the current specific conductance exceedances and no upgradient contributions are identified.

The entire 216-A-29 Ditch groundwater monitoring network will be sampled for supporting constituents and field parameters throughout the assessment. Monitoring well attributes are provided in Table 3-3, and well locations are shown on Figure 3-1. Another well network configuration (as described in the revised indicator parameter evaluation plan) may be used during the assessment, if needed, depending on the results after the first year of the assessment plan's evaluation process. The well attributes for the future well network are provided in Table 3-4. The future well network configuration is shown in Figure 3-2.

Table 3-1. Dangerous Waste Constituents Included in 216-A-29 Ditch Groundwater Quality Assessment

Constituent	Chemical Abstracts Service Number	Constituent	Chemical Abstracts Service Number
Anions			
Cyanide	57-12-5	Sulfide	18496-25-8
Metals			
Antimony	7440-36-0	Mercury	7439-97-6
Arsenic	7440-38-2	Nickel	7440-02-0
Barium	7440-39-3	Selenium	7782-49-2
Beryllium	7440-41-7	Silver	7440-22-4
Cadmium	7440-43-9	Thallium	7440-28-0
Chromium	7440-47-3	Tin	7440-31-5
Cobalt	7440-48-4	Vanadium	7440-62-2
Copper	7440-50-8	Zinc	7440-66-6
Lead	7439-92-1		

Table 3-1. Dangerous Waste Constituents Included in 216-A-29 Ditch Groundwater Quality Assessment

Constituent	Chemical Abstracts Service Number	Constituent	Chemical Abstracts Service Number
Volatile Organic Compounds			
1,1-Dichloroethane	75-34-3	Carbon Tetrachloride	56-23-5
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	Chlorobenzene	108-90-7
1,1,1-Trichloroethane	71-55-6	Chloroethane	75-00-3
1,1,1,2-Tetrachloroethane	630-20-6	Chloroform	67-66-3
1,1,2-Trichloroethane	79-00-5	Chloroprene	126-99-8
1,1,2,2-Tetrachloroethane	79-34-5	Dibromochloromethane	124-48-1
1,2-Dibromo-3-chloropropane	96-12-8	*p*-Dichlorobenzene (1,4-Dichlorobenzene)	106-46-7
1,2-Dibromoethane	106-93-4	Dichlorodifluoromethane	75-71-8
1,2-Dichloroethane	107-06-2	Ethylbenzene	100-41-4
1,2-Dichloropropane	78-87-5	Ethyl Methacrylate	97-63-2
trans-1,2-Dichloroethylene	156-60-5	Isobutanol (Isobutyl Alcohol)	78-83-1
1,2,3-Trichloropropane	96-18-4	Methacrylonitrile	126-98-7
cis-1,3-Dichloropropene	10061-01-5	Methyl Bromide (Bromomethane)	74-83-9
trans-1,3-Dichloropropene	10061-02-6	Methyl Chloride (Chloromethane)	74-87-3
trans-1,4-Dichloro-2-butene	110-57-6	Methyl Iodide (Iodomethane)	74-88-4
2-Butanone (Methyl Ethyl Ketone)	78-93-3	Methyl methacrylate	80-62-6
2-Propanone (Acetone)	67-64-1	Methylene bromide (Dibromomethane)	74-95-3
2-Hexanone	591-78-6	Methylene chloride	75-09-2
4-Methyl-2-pentanone	108-10-1	Propionitrile (Ethyl Cyanide)	107-12-0
Acetonitrile; Methyl Cyanide	75-05-8	Styrene	100-42-5
Acrolein	107-02-8	Tetrachloroethene	127-18-4
Acrylonitrile	107-13-1	Toluene	108-88-3
Allyl Chloride	107-05-1	Trichloroethene (TCE)	79-01-6
Benzene	71-43-2	Trichlorofluoromethane	75-69-4
Bromodichloromethane	75-27-4	Vinyl Acetate	108-05-4

Table 3-1. Dangerous Waste Constituents Included in 216-A-29 Ditch Groundwater Quality Assessment

Constituent	Chemical Abstracts Service Number	Constituent	Chemical Abstracts Service Number
Bromoform	75-25-2	Vinyl Chloride (Chloroethene)	75-01-4
Carbon Disulfide	75-15-0	Xylenes (Total)	1330-20-7
Semivolatile Organic Compounds			
1-Naphthylamine	134-32-7	Dimethyl Phthalate	131-11-3
1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1	Di-n-butylphthalate	84-74-2
1,2,4-Trichlorobenzene	120-82-1	m-Dinitrobenzene	99-65-0
1,2,4,5-Tetrachlorobenzene	95-94-3	Di-n-octylphthalate	117-84-0
1,4-Dioxane	123-91-1	Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	88-85-7
1,4-Naphthoquinone	130-15-4	Diphenylamine	122-39-4
2-Acetylaminofluorene	53-96-3	Disulfoton	298-04-4
2-Chloronaphthalene	91-58-7	Ethyl Methanesulfonate	62-50-0
2-Chlorophenol	95-57-8	Famphur	52-85-7
2-Methylphenol (*o*-cresol)	95-48-7	Fluoranthene	206-44-0
2-Methylnaphthalene	91-57-6	9H-Fluorene (Fluorene)	86-73-7
2-Naphthylamine	91-59-8	Hexachlorobenzene	118-74-1
2-Nitrophenol (o-Nitrophenol)	88-75-5	Hexachlorobutadiene	87-68-3
2-Picoline	109-06-8	Hexachlorocyclopentadiene	77-47-4
2,3,4,6-Tetrachlorophenol	58-90-2	Hexachloroethane	67-72-1
2,4-Dichlorophenol	120-83-2	Hexachlorophene	70-30-4
2,4-Dimethylphenol	105-67-9	Hexachloropropene	1888-71-7
2,4-Dinitrophenol	51-28-5	Indeno(1,2,3-cd)pyrene	193-39-5
2,4-Dinitrotoluene	121-14-2	Isodrin	465-73-6
2,4,5-Trichlorophenol	95-95-4	Isophorone	78-59-1
2,4,6-Trichlorophenol	88-06-2	Isosafrole	120-58-1
2,6-Dichlorophenol	87-65-0	Kepone	143-50-0
2,6-Dinitrotoluene	606-20-2	Methapyrilene	91-80-5
3-Methylcholanthrene	56-49-5	Methyl Methanesulfonate	66-27-3
3-Methylphenol (*m*-cresol)	108-39-4	Methyl Parathion	298-00-0

Table 3-1. Dangerous Waste Constituents Included in 216-A-29 Ditch Groundwater Quality Assessment

Constituent	Chemical Abstracts Service Number	Constituent	Chemical Abstracts Service Number
4-Methylphenol (*p*-cresol)	106-44-5	Naphthalene	91-20-3
3,3′-Dichlorobenzidine	91-94-1	Nitrobenzene	98-95-3
3,3′-Dimethylbenzidine	119-93-7	o-Nitroaniline (2-Nitroaniline)	88-74-4
4-Aminobiphenyl	92-67-1	m-Nitroaniline (3-Nitroaniline)	99-09-2
4-Bromophenyl phenyl ether	101-55-3	p-Nitroaniline (4-Nitroaniline)	100-01-6
4-Chloro-3-methylphenol (*p*-Chloro-*m*-cresol)	59-50-7	p-Nitrophenol (4-Nitrophenol)	100-02-7
4-Chlorophenyl phenyl ether	7005-72-3	N-Nitrosodi-n-butylamine	924-16-3
4-Nitroquinoline 1-oxide	56-57-5	N-Nitrosodiethylamine	55-18-5
4,6-Dinitro-*o*-cresol (4,6-Dinitro-2-methyl phenol)	534-52-1	N-Nitrosodimethylamine	62-75-9
5-Nitro-o-toluidine	99-55-8	N-Nitrosodiphenylamine	86-30-6
7,12-Dimethylbenz[a]anthracene	57-97-6	n-Nitroso-di-n-dipropylamine (N-Nitrosodipropylamine; Di-n-propylnitrosamine)	621-64-7
Acenaphthene	83-32-9	N-Nitrosomethylethalamine	10595-95-6
Acenaphthylene	208-96-8	n-Nitrosomorpholine	59-89-2
Acetophenone	98-86-2	N-Nitrosopiperidine	100-75-4
Aniline	62-53-3	N-Nitrosopyrrolidine	930-55-2
Anthracene	120-12-7	Parathion	56-38-2
Aramite	140-57-8	Pentachlorobenzene	608-93-5
Benz[a]anthracene (Benzo[a]anthracene)	56-55-3	Pentachloroethane	76-01-7
Benz[e]acephenanthrylene (Benzo[b]fluoranthene)	205-99-2	Pentachloronitrobenzene	82-68-8
Benzo[k]fluoranthene	207-08-9	Pentachlorophenol	87-86-5
Benzo[ghi]perylene	191-24-2	Phenacetin	62-44-2
Benzo[a]pyrene	50-32-8	Phenanthrene	85-01-8
Benzyl alcohol	100-51-6	Phenol	108-95-2
Bis(2-chloroethoxy)methane	111-91-1	p-Phenylenediamine	106-50-3
Bis(2-chloroethyl)ether	111-44-4	Phorate	298-02-2

Table 3-1. Dangerous Waste Constituents Included in 216-A-29 Ditch Groundwater Quality Assessment

Constituent	Chemical Abstracts Service Number	Constituent	Chemical Abstracts Service Number
Bis(2-chloro-1-methylethyl) ether (2,2'-Oxybis(1-chloropropane))	108-60-1	Pronamide	23950-58-5
Bis(2-ethylhexyl) phthalate	117-81-7	Pyrene	129-00-0
Butylbenzylphthalate	85-68-7	Pyridine	110-86-1
p-Chloroaniline (4-Chloroaniline)	106-47-8	Safrole	94-59-7
Chlorobenzilate	510-15-6	Tetraethyl dithiopyrophosphate	3689-24-5
Chrysene	218-01-9	o-Toluidine	95-53-4
Diallate	2303-16-4	O,O,O-Triethyl phosphorothioate	126-68-1
Dibenz[a,h]anthracene	53-70-3	sym-Trinitrobenzene	99-35-4
Dibenzofuran	132-64-9	Aroclor 1016	12674-11-2
m-Dichlorobenzene (1,3-Dichlorobenzene)	541-73-1	Aroclor 1221	11104-28-2
Diethyl phthalate	84-66-2	Aroclor 1232	11141-16-5
O,O-Diethyl O-2-pyrazinyl phosphorothioate	297-97-2	Aroclor 1242	53469-21-9
Dimethoate	60-51-5	Aroclor 1248	12672-29-6
p-(Dimethylamino)azobenzene	60-11-7	Aroclor 1254	11097-69-1
alpha, alpha-Dimethylphenethylamine	122-09-8	Aroclor 1260	11096-82-5

Table 3-2. Constituent List and Sampling Frequency 216-A-29 Ditch Groundwater Quality Assessment Monitoring

Well	WAC Compliant	Supporting Constituents						Field Parameters					Dangerous Waste Constituents
		Alkalinity[a]	Anions[b]	Metals (Filtered and Unfiltered)[c]	Phenols	Total Organic Carbon	Total Organic Halogen	pH	Specific Conductance	Temperature	Turbidity	Water Level	Table 3-1[d]
299-E25-2	N	S	S	S	S	S4	S4	S4	S4	S	S	S	S
299-E25-26	N	S	S	S	S	S4	S4	S4	S4	S	S	S	--
299-E25-28	Y	S	S	S	S	S4	S4	S4	S4	S	S	S	--
299-E25-32P	Y	S	S	S	S	S4	S4	S4	S4	S	S	S	S
299-E25-34	Y	S	S	S	S	S4	S4	S4	S4	S	S	S	--
299-E25-35	Y	S	S	S	S	S4	S4	S4	S4	S	S	S	S
299-E25-48	Y	S	S	S	S	S4	S4	S4	S4	S	S	S	S
299-E26-12	Y	S	S	S	S	S4	S4	S4	S4	S	S	S	--
299-E26-13	Y	S	S	S	S	S4	S4	S4	S4	S	S	S	S
699-43-45	Y	S	S	S	S	S4	S4	S4	S4	S	S	S	--

Table 3-2. Constituent List and Sampling Frequency 216-A-29 Ditch Groundwater Quality Assessment Monitoring

		Supporting Constituents						Field Parameters					Dangerous Waste Constituents
Well	WAC Compliant	Alkalinity[a]	Anions[b]	Metals (Filtered and Unfiltered)[c]	Phenols	Total Organic Carbon	Total Organic Halogen	pH	Specific Conductance	Temperature	Turbidity	Water Level	Table 3-1[d]

Notes: Bold print indicates an upgradient well.

This constituent list and sampling frequency initiates the assessment plan evaluations. Section 4.1 of this assessment plan discusses the data evaluation process that could result in a modification to this table.

a. Alkalinity includes analysis of bicarbonate alkalinity.

b. Anions include, as a minimum, bicarbonate, chloride, nitrate, and sulfate.

c. Metals (filtered and unfiltered) include, as a minimum, calcium, magnesium, potassium, sodium, chromium, manganese, nickel, and iron.

d. Metals identified in Table 3-1 include filtered and unfiltered. They includes antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, tin, vanadium, and zinc.

N = Well is not constructed as a resource protection well under WAC 173-160, “Minimum Standards for Construction and Maintenance of Wells”

S = semiannually

S4 = to be sampled semiannually with quadruplicate samples taken

WAC = *Washington Administrative Code*

Y = Well is constructed as a resource protection well under WAC 173-160

3.2 Monitoring Well Network

Construction details and pertinent information for the monitoring wells that will be used during the initial assessment plan evaluation are provided in Table 3-3 and Appendix C.

Assessment monitoring activities will start with utilization of the wells identified in the 2010 monitoring plan (DOE/RL-2008-58, Rev. 0). To support the assessment plan and provide additional upgradient constituent concentration data, Well 299-E25-2 will be added to the current network. In the future, if needed for continued assessment data collection, the well network provided in the revised indicator parameter evaluation plan (DOE/RL-2008-58, Draft Rev. 1) may be used. The three additional new wells identified on Figure 3-2 are now on the CH2M HILL Plateau Remediation Company/U.S. Department of Energy buy-back list as a high priority.

Table 3-3. Attributes for Wells to be Used in the Initial 2016 Assessment

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Screen Top (m [ft] bgs)	Screen Bottom (m [ft] bgs)	Water Depth (m [ft] bgs)	Remaining Water Column (m [ft])	Water Level Date
299-E25-2	1955	575513.76	136061.87	84.2 (276)	96.3 (316)	84.7 (278)	11.7 (38.4)	3/3/15
299-E25-26	1985	575907.50	135912.86	82.3 (270)	88.4 (290)	83.2 (273)	5.3 (17.4)	4/1/15
299-E25-28[b]	1985	576011.77	136111.69	97.5 (320)	103.6 (340)	80.6 (264.5)	6.1 (20)	11/16/2015
299 E25-32P	1988	576382.42	136044.34	79.1 (260)	85.2 (280)	83.1 (273)	2.1 (6.9)	4/23/15
299 E25-34	1988	576019.04	136100.01	76.7 (252)	82.8 (272)	80.8 (265)	2.1 (6.9)	4/29/15
299 E25-35	1988	575708.34	135864.69	79.4 (260)	85.7 (281)	83.9 (275)	1.8 (6.0)	4/29/15
299-E25-48	1992	575623.85	135815.69	83.6 (274.3)	89.8 (294.6)	86.4 (283.4)	3.4 (11.2)	10/9/2015
299-E26-12	1991	576197.7	136383.2	66.3 (217.6)	72.7 (238.6)	70.4 (231.1)	2.3 (7.5)	11/04/2015
299 E26-13	1991	576199.30	136528.60	58.5 (192)	64.7 (212)	62.7 (206)	2.1 (6.9)	4/29/15
699-43-45	1989	576283.82	136585.73	55.8 (183)	62 (203.3)	60.4 (198.3)	1.5 (4.99)	10/16/2015

Note: Upgradient wells in **bold**

a. Coordinates are in NAD83, *North American Datum of 1983*.
b. Deep well; data used are for information purposes only, not for assessment evaluations.

bgs = below ground surface

NA = not applicable

TBD = to be determined

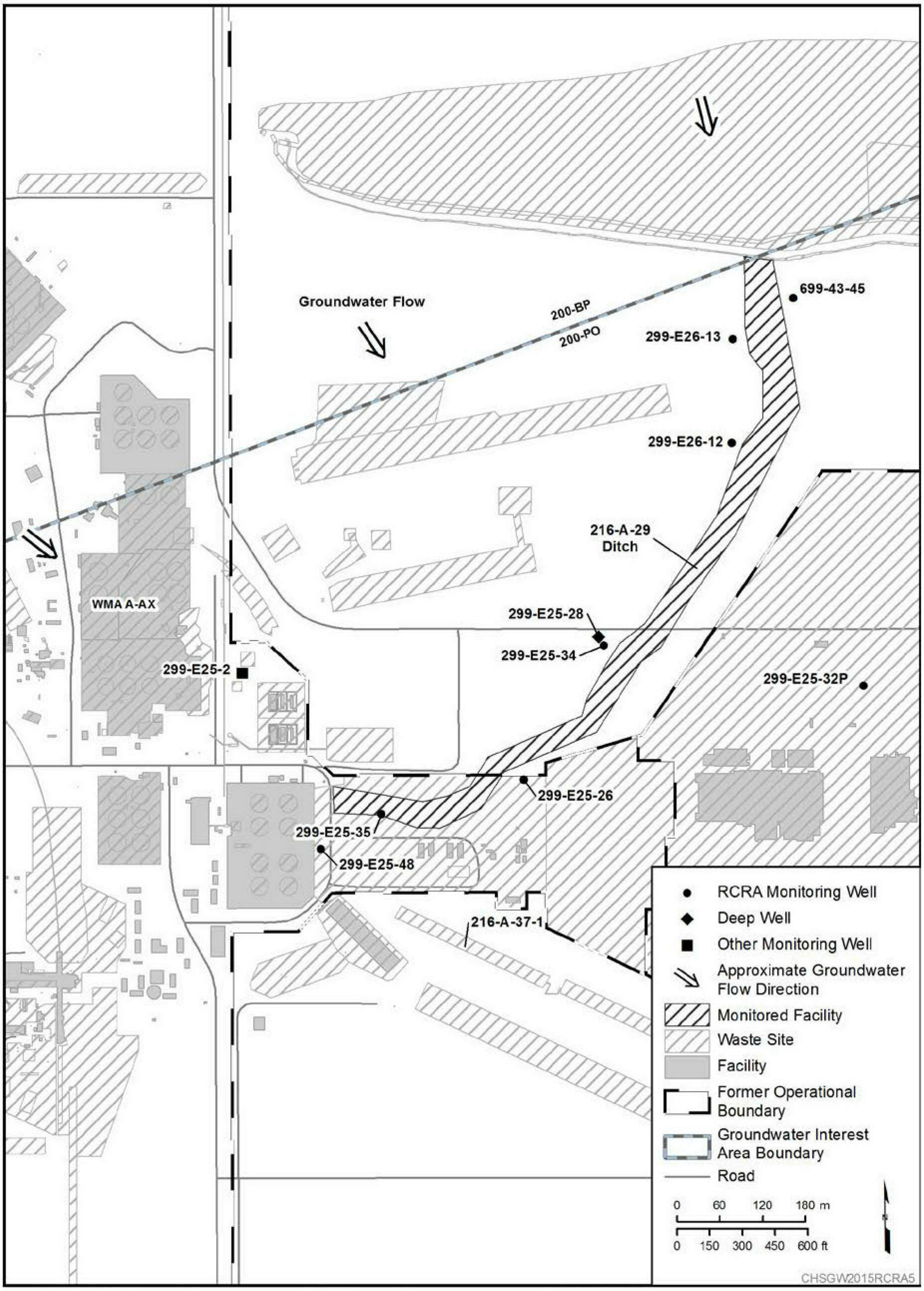
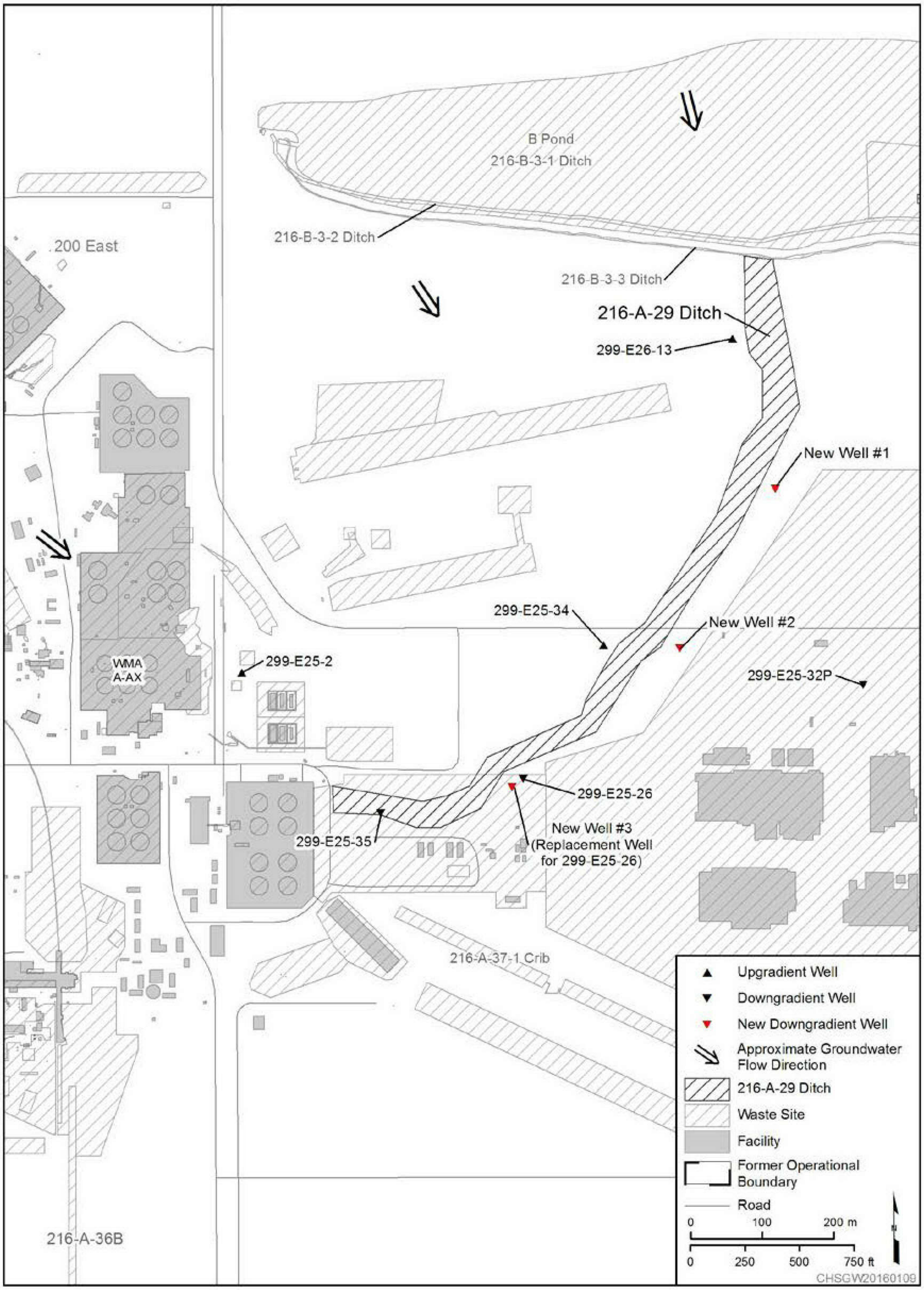


Figure 3-1. Well Network Configuration for 2016 Assessment Monitoring



Note: If needed for continued assessment data collection, this revised well network may be used.

Source: DOE/RL-2008-58, Draft Rev, 1.

Figure 3-2. Well Network Configuration

Table 3-4. Attributes for Wells that may be Used in the Future 216-A-29 Ditch Groundwater Quality Assessment Monitoring

Well Name	Completion Date	Easting* (m)	Northing* (m)	Screen Top (m [ft] bgs)	Screen Bottom (m [ft] bgs)	Water Depth (m [ft] bgs)	Remaining Water Column (m [ft])	Water Level Date
299-E25-2	1955	575513.76	136061.87	84.2 (276)	96.3 (316)	84.7 (278)	11.7 (38.4)	3/3/15
299-E25-26	1985	575907.50	135912.86	82.3 (270)	88.4 (290)	83.2 (273)	5.3 (17.4)	4/1/15
299 E25-32P	1988	576382.42	136044.34	79.1 (260)	85.2 (280)	83.1 (273)	2.1 (6.9)	4/23/15
299 E25-34	1988	576019.04	136100.01	76.7 (252)	82.8 (272)	80.8 (265)	2.1 (6.9)	4/29/15
299 E25-35	1988	575708.34	135864.69	79.4 (260)	85.7 (281)	83.9 (275)	1.8 (6.0)	4/29/15
299 E26-13	1991	576199.30	136528.60	58.5 (192)	64.7 (212)	62.7 (206)	2.1 (6.9)	4/29/15
New Well # 1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	NA
New Well # 2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	NA
New Well # 3 (replacement for 299-E25-26)	TDB	TBD	TBD	TBD	TBD	TBD	TBD	NA

Note: In the future, if needed for continued assessment data collection, this revised well network may be used (modified from DOE/RL-2008-58, Draft Rev. 1).pgradient wells are in **bold.**

* Coordinates are in NAD83, *North American Datum of 1983*.

bgs = below ground surface

NA = not applicable

TBD = to be determined

4 Data Evaluation and Reporting

The data review and verification are discussed in the quality assurance project plan (Appendix A of the revised indicator parameter evaluation plan).

4.1 Data Evaluation

The process to be followed to determine if dangerous waste or dangerous waste constituents are present in groundwater due to releases from the 216-A-29 Ditch is provided below. The following sampling and data evaluation logic considers whether the exceedance of the specific conductance indicator parameter is related to one of the following: 1) the presence of a dangerous waste constituent released from the site, 2) dangerous constituents at naturally occurring concentrations, or 3) is the result of migration of dangerous waste constituent or naturally occurring constituents from an upgradient source(s).

During the first year of this assessment, samples will be collected at a semiannual frequency for supporting constituents, field parameters and dangerous waste constituents at the wells identified in Table 3-2. Wells that exceeded the critical mean for specific conductance (299-E25-32P, 299E25-35, and 299-E25-48) and upgradient wells 299-E25-2 and 299-E25-13 will be targeted for analysis of dangerous waste constituents.

After all laboratory results from the first and second assessment sampling events are available, an initial data evaluation will be conducted. The data analysis and review process presented below will be implemented. The process decision logic identifies subsequent alternative actions to be taken. In the initial data evaluation, any dangerous waste constituents detected will be identified. Two consecutive detections or nondetects are needed to verify presence or absence of a dangerous waste constituent.

Initial Data Evaluation

Step 1 – Based on the laboratory results from the first and second assessment sampling events, determine if the analytical results for the constituent is a nondetect or is at a background concentration. Use Hanford Site background concentrations (DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*) for comparisons of applicable inorganics.

- If yes, exclude constituent from further assessment monitoring.
- If no, continue with the next step in the initial data evaluation.

Step 2 – Do any of the downgradient wells have detections of the dangerous waste constituents identified in Table 3-2?

- If yes, continue with evaluation process for dangerous waste constituents.
- If no, continue with evaluation process for nondangerous waste constituents.

Dangerous Waste Constituent Evaluation Process Steps

Step 1 – Is the well network configured appropriately with respect with the groundwater flow such that the upgradient well data is representative of upgradient constituent concentrations and downgradient well data is representative of downgradient constituent concentrations?

- If yes, continue with Step 2 in evaluation process for dangerous waste constituents.

- If no, retain the constituent, and redefine the monitoring network such that the wells are appropriately aligned to monitor contaminant conditions upgradient and downgradient of the waste site.

- Continue assessment monitoring after well realignment.

Step 2 – Is the downgradient dangerous waste constituent concentration greater than the upgradient concentration?

- If yes, continue assessment monitoring. Include constituent as part of assessment monitoring contaminant list in the first determination report.

- If no, continue to Step 3 in evaluation process for dangerous waste constituents.

Step 3 – Are there any laboratory errors or uncertainties associated with the dangerous waste constituent analytical value that would qualify the result as not valid?

- If yes, include the constituent in the next sampling event to reevaluate the analytical result.

- If no, continue to Step 4 in evaluation process for dangerous waste constituents.

Step 4 – Repeat the logic process for evaluation of those dangerous waste constituents identified as requiring further analysis in a subsequent sampling event. Upon completion of all needed sampling events, results of the data evaluation are presented in the first determination report.

Nondangerous Waste Constituent Evaluation Process Steps

Step 1 – Is the well network configured appropriately with respect with the groundwater flow such that the upgradient well data is representative of upgradient supporting constituent/field parameter values and downgradient well data is representative of downgradient supporting constituent/field parameter values?

- If yes, continue with Step 2 in evaluation process for nondangerous waste constituents.

- If no, redefine the monitoring network such that the wells are appropriately aligned to monitor groundwater conditions for the supporting constituent/field parameter values upgradient and downgradient of the waste site.

Step 2 – Is the upgradient supporting constituent/field parameter value greater than the downgradient value?

- If yes, identify the supporting constituent/field parameter for inclusion for discussion in the first determination report if needed to define an upgradient contribution to downgradient values.

- If no, identify the supporting constituent/field parameter value as resulting from a nondangerous waste contribution from the site that is impacting downgradient values and include in the discussion in the first determination report.

Based on the results of the first year of sampling, further actions may be required such as reconfiguration of the well network for proper alignment with the groundwater flow direction and/or determination of the full extent of dangerous waste or dangerous waste constituents in groundwater from the 216-A-29 Ditch. After all dangerous waste constituents identified in Table 3-2 have been evaluated, any well realignments or new well installations identified have been completed, and any iterative sampling and data evaluation process steps have been conducted, a first determination report will be completed.

This assessment plan will be revised to update the constituents and sampling frequency in accordance with the findings of the data evaluations and any changes made to the well network configuration. Any dangerous waste constituent(s) identified in Table 3-2 that is determined to be attributed to a release from 216-A-29 waste site will be included in the first determination report and in routine monitoring at a quarterly frequency. Dangerous waste constituents identified in Table 3-2 that are not detected or not attributable to 216-A-29 will be removed from the groundwater monitoring plan.

If it is determined that dangerous waste constituents have entered the groundwater from the 216-A-29 Ditch, the current rate and extent of contaminant migration and concentration of the constituents in groundwater will be determined and identified in the first determination report. Further determinations will be made on a quarterly basis until facility closure. The results will be discussed in annual groundwater monitoring reports (e.g., DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014*) that will provide the basis for the extent of contamination.

If the first determination finds that no dangerous waste or dangerous waste constituents identified in Table 3-2 from the 216-A-29 Ditch have contaminated the groundwater, then monitoring will return to an indicator evaluation program under WAC 173-303-400 and 40 CFR 265.92, "Sampling and Analysis."

4.2 Annual Determination of Monitoring Network

The RCRA groundwater monitoring requirements include an annual evaluation of the monitoring well network to determine if it remains adequate to monitor the site. The network must include upgradient and downgradient wells in the uppermost aquifer (40 CFR 265.91(a)(1) and (2), "Ground-Water Monitoring System").

The groundwater monitoring network will continue to be re-evaluated annually to ensure that it is adequate to monitor any changing hydrogeologic conditions beneath the site. If flow changes are observed, the 216-A-29 conceptual site model and groundwater constituents will be re-evaluated to determine network efficiency and any necessary modification requirements for the network.

Water level measurements will continue to be collected before each sampling event. An additional and more comprehensive set of water level measurements is made annually for selected wells on the Hanford Site, and the data are presented in the annual groundwater monitoring reports (e.g., DOE/RL-2015-07).

4.3 Reporting and Notification

Groundwater monitoring results are reported annually in accordance with the requirements of 40 CFR 265.94(b)(2). Reporting will be made in the annual groundwater monitoring reports.

A first determination report containing an assessment of groundwater quality based on the result of the assessment plan under 40 CFR 265.93(d)(4) will be prepared as soon as technically feasible. This report will be submitted to Ecology within 15 days of issuance as required by 40 CFR 265.93(d)(5) and WAC 173-303-400(3)(c)(v)(E).

If as a result of the assessment plan under 40 CFR 265.93(d)(4), it is determined that no dangerous waste or dangerous waste constituents from the facility have entered the groundwater, and an indicator evaluation groundwater monitoring program is reinstated, Ecology will be notified of this reinstatement in the first determination report as required by 40 CFR 265.93(d)(6) and WAC 173-303-400(3)(b)(i).

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5 Implementation Schedule

This chapter summarizes the anticipated sequencing of activities, tentative implementation or completion dates, well networks to be used, and a description of the activity being conducted. For some activities, the actions to be taken are dependent on review of the results at that stage of the assessment. The summary is provided in Table 5-1.

Table 5-1. Groundwater Quality Assessment Monitoring Program Implementation Schedule

Activity	Target Tentative Date	Well Network Definition	Comment
First Assessment Sampling Event	Semiannual (April 2016)	Table 3-2, Figure 3-1	Supporting constituents and field parameters collected at all network wells. Dangerous waste constituent sampling at three wells with specific conductance exceedances (299-E25-32P, 299-E25-35, and 299-E25-48) and 2 wells upgradient of exceedance wells (Well 299-E25-2 and 299-E25-12).
Second Assessment Sampling Event	Semiannual (October 2016)	Table 3-2, Figure 3-1	Supporting constituents and field parameters collected at all network wells. Dangerous waste constituent sampling at three wells with specific conductance exceedances (299-E25-32P, 299-E25-35, and 299-E25-48) and 2 wells upgradient of exceedance wells (Well 299-E25-2 and 299-E25-12).
Initial Data Evaluation	December 2016	Table 3-2, Figure 3-1	Review analytical results of the first and second assessment semiannual sampling events.
First Revision of Assessment Plan	2017	--	Revise assessment plan if needed, or proceed with completion of first determination report if no dangerous waste constituents detected. Revised plan extends assessment constituent sampling to other network wells if dangerous waste constituents identified at any of the 3 wells with specific conductane exceedances and there are no detections for the dangerous waste constituents at wells upgradient of exceedance wells.
Assessment Sampling Events	Semiannual (April 2017)	--	Conducted if additional data collection is needed. Follow process outlined in revised assessment plan if developed. Assessment sampling continues as needed until first determination report is completed.
Revision of Assessment Plan When Proposed Future Well Network Completed	After installation of 3 new wells	Future Well Network is provided in Table 3-4, Figure 3-2	Conducted if additional data collection is needed. Follow process outlined in revised assessment plan if developed. Assessment sampling continues as needed until first determination report is completed.

Table 5-1. Groundwater Quality Assessment Monitoring Program Implementation Schedule

Activity	Target Tentative Date	Well Network Definition	Comment
Sampling Event with Proposed Future Well Network	Semiannual	Table 3-4, Figure 3-2	Assessment sampling continues if needed until first determination report is completed.
Complete First Determination Report	TBD	--	Date of completion and issuance dependent on activities needed to finish data evaluation process.
Submit First Determination Report to Ecology	Within 15 days of report issuance	--	--

6 References

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265.91, "Ground-Water Monitoring System."

265.92, "Sampling and Analysis."

265.93, "Preparation, Evaluation, and Response."

265.94, "Recordkeeping and Reporting."

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Appendix A

Quality Assurance Project Plan Tables

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Contents

Tables

Terms

DUP	laboratory sample duplicate
EB	equipment blank
EPA	U.S. Environmental Protection Agency
FTB	full trip blank
GC	gas chromatography
GC-MS	gas chromatography-mass spectrometry
LCS	laboratory control sample
MB	method blank
MCL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
PCB	polychlorinated biphenyl
PQL	practical quantitation limit
QAPjP	quality assurance project plan
RPD	relative percent difference
SUR	surrogate

A1 Introduction

For the most part, the quality assurance project plan (QAPjP) provided in DOE/RL-2008-58, Draft Rev. 1 for the indicator parameter evaluation program will be used for this groundwater quality assessment program monitoring plan. The DOE/RL-2008-58, Draft Rev. 1 QAPjP is modified in the following manner:

- References to the indicator parameter program (40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis") and indicator parameter program elements (such as 40 CFR 265.94(a)) are replaced with the quality assessment program (40 CFR 265.93(d)(3) and (4), "Preparation, Evaluation, and Response").
- Records of data analyses and evaluations specified in the quality assessment plan to satisfy 40 CFR 265.93(d)(3) and (4) are kept as required by 40 CFR 265.94(b)(1), "Recordkeeping and Reporting."
- DOE/RL-2008-58, Draft Rev. 1 Tables A-3 through A-6 are replaced with Tables A-1 through A-4 as provided in this quality assessment plan.

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)
General Chemistry Analyses		
Alkalinity[d]	EPA/600 Method 310.1 or Standard Method 2320	5,000
Bicarbonate Alkalinity		-[e]
pH	Field Measurement Instrument/meter	N/A
Specific Conductance		N/A
Temperature		N/A
Turbidity		N/A
Total Organic Carbon	SW-846 Method 9060	1,000
Total Organic Halogen	SW-846 Method 9020	10
Anions		
Chloride[c]	EPA/600 Method 300.0	400
Nitrate[c]		250
Sulfate[c]		550
Cyanide	SW-846 Method 351.2	20
Sulfide	SW-846 Method 376.1 or 9034	2,000
Metals		
Antimony	SW-846 Method 6010B/C	60

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)
Arsenic		10
Barium		100
Beryllium		5
Cadmium		5
Calcium		1,000
Chromium		10
Cobalt		50
Copper		25
Iron		100
Lead		15
Magnesium		1,000
Manganese		15
Nickel		40
Potassium		5,000
Selenium		50
Silver		10
Sodium		1,000
Thallium		50
Tin		100
Vanadium		50
Zinc		20
Mercury	SW-846 Method 7470	0.5
Volatile Organic Compounds		
1,1-Dichloroethane	SW-846 Method 8260	10
1,1-Dichloroethene (1,1-Dichloroethylene)		10
1,1,1-Trichloroethane		5
1,1,1,2-Tetrachloroethane		1.7
1,1,2-Trichloroethane		5
1,1,2,2-Tetrachloroethane		5

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)
1,2-Dibromo-3-chloropropane		5
1,2-Dibromoethane		5
1,2-Dichloroethane		5
1,2-Dichloropropane		5
trans-1,2-Dichloroethylene		5
1,2,3-Trichloropropane		5
cis-1,3-Dichloropropene		5
trans-1,3-Dichloropropene		5
trans-1,4-Dichloro-2-butene		50
2-Butanone (Methyl Ethyl Ketone)		10
2-Propanone (Acetone)		20
2-Hexanone		20
4-Methyl-2-pentanone		10
Acetonitrile; Methyl Cyanide		100
Acrolein		100
Acrylonitrile		100
Allyl chloride		10
Benzene		5
Bromodichloromethane		5
Bromoform		5
Carbon Disulfide		5
Carbon Tetrachloride		3
Chlorobenzene		5
Chloroethane		10
Chloroform		5
Chloroprene		10
Dibromochloromethane		5
p-Dichlorobenzene (1,4-Dichlorobenzene)		4
Dichlorodifluoromethane		10

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)
Ethylbenzene		4
Ethyl Methacrylate		10
Isobutyl Alcohol		500
Methacrylonitrile		10
Methyl Bromide (Bromomethane)		10
Methyl Chloride (Chloromethane)		10
Methyl Iodide (Iodomethane)		10
Methyl Methacrylate		10
Methylene Bromide (Dibromomethane)		10
Methylene Chloride		5
Propionitrile (Ethyl Cyanide)		10
Styrene		5
Tetrachloroethene		5
Toluene		5
Trichloroethene (TCE)		1
Trichlorofluoromethane		10
Vinyl Acetate		50
Vinyl Chloride (Chloroethene)		10
Xylenes (Total)		10
Semivolatile Organic Compounds		
1-Naphthylamine	SW-846 Method 8270	25
1,2-Dichlorobenzene (*o*-Dichlorobenzene)		10
1,2,4-Trichlorobenzene		13
1,2,4,5-Tetrachlorobenzene		20
1,4-Dioxane		10
1,4-Naphthoquinone		50
2-Acetylaminofluorene		100
2-Chloronaphthalene		10
2-Chlorophenol		10

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)
2-Methylphenol (*o*-Cresol)		10
2-Methylnaphthalene		10
2-Naphthylamine		10
2-Nitrophenol (*o*-Nitrophenol)		10
2-Picoline		20
2,3,4,6-Tetrachlorophenol		50
2,4-Dichlorophenol		10
2,4-Dimethylphenol		10
2,4-Dinitrophenol		50
2,4-Dinitrotoluene		10
2,4,5-Trichlorophenol		10
2,4,6-Trichlorophenol		10
2,6-Dichlorophenol		10
2,6-Dinitrotoluene		10
3-Methylcholanthrene		20
3- and 4-Methylphenol (*m*- and *p*-cresol)		20
3,3′-Dichlorobenzidine		50
3,3′-Dimethylbenzidine		50
4-Aminobiphenyl		50
4-Bromophenyl phenyl ether		10
4-Chloro-3-methylphenol (*p*-Chloro-*m*-cresol)		10
4-Chlorophenyl phenyl ether		10
4-Nitroquinoline 1-oxide		100
4,6-Dinitro-o-cresol (4,6-Dinitro-2-methyl phenol)		20
5-Nitro-o-toluidine		20
7,12-Dimethylbenz[a]anthracene		20
Acenaphthene		10
Acenaphthylene (Acenaphthylene)		10

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)
Acetophenone		10
Aniline		10
Anthracene		10
Aramite		20
Benz[a]anthracene (Benzo[a]anthracene)		10
Benz[e]acephenanthrylene (Benzo[b]fluoranthene)		10
Benzo[k]fluoranthene		10
Benzo[ghi]perylene		10
Benzo[a]pyrene		10
Benzyl Alcohol		10
Bis(2-chloroethoxy)methane		10
Bis(2-chloroethyl)ether		10
Bis(2-chloro-1-methylethyl) ether (2,2'-Oxybis(1-chloropropane))		10
Bis(2-ethylhexyl) phthalate		10
Butyl benzyl phthalate		10
p-Chloroaniline (4-Chloroaniline)		10
Chlorobenzilate		10
Chrysene		10
Diallate		20
Dibenz[a,h]anthracene		10
Dibenzofuran		10
m-Dichlorobenzene (1,3-Dichlorobenzene)		10
Diethyl phthalate		10
O,O-Diethyl O-2-pyrazinyl phosphorothioate		50
Dimethoate		20
p-(Dimethylamino)azobenzene		10
alpha, alpha-Dimethylphenethylamine		50
Dimethyl phthalate		10
Di-n-butyl phthalate		10

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)
m-Dinitrobenzene (1,3-dinitrobenzene)		10
Di-n-octyl Phthalate		10
Dinoseb (2-sec-Butyl-4,6-dinitrophenol)		20
Diphenylamine		10
Disulfoton		50
Ethyl Methanesulfonate		10
Famphur		100
Fluoranthene		10
9H-Fluorene (Fluorene)		10
Hexachlorobenzene		10
Hexachlorobutadiene		10
Hexachlorocyclopentadiene		10
Hexachloroethane		10
Hexachlorophene		500
Hexachloropropene		100
Indeno(1,2,3-cd)pyrene		10
Isodrin		10
Isophorone		10
Isosafrole		20
Kepone		100
Methapyrilene		50
Methyl Methanesulfonate		10
Methyl Parathion		10
Naphthalene		10
Nitrobenzene		10
o-Nitroaniline (2-Nitroaniline)		10
m-Nitroaniline (3-Nitroaniline)		10
p-Nitroaniline (4-Nitroaniline)		10
p-Nitrophenol (4-Nitrophenol)		10

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)
N-Nitrosodi-n-butylamine		10
N-Nitrosodiethylamine		10
N-Nitrosodimethylamine		10
N-Nitrosodiphenylamine		10
n-Nitroso-di-n-dipropylamine (N-Nitrosodipropylamine; Di-n-propylnitrosamine)		10
N-Nitrosomethylethalamine		10
n-Nitrosomorpholine		10
N-Nitrosopiperidine		2
N-Nitrosopyrrolidine		10
Parathion		50
Pentachlorobenzene		10
Pentachloroethane		50
Pentachloronitrobenzene		50
Pentachlorophenol		10
Phenacetin		20
Phenanthrene		10
Phenols		10 [f]
p-Phenylenediamine		500
Phorate		50
Pronamide		20
Pyrene		10
Pyridine		20
Safrole		20
Tetraethyl Dithiopyrophosphate		50
o-Toluidine		20
O,O,O-Triethyl Phosphorothioate		50
sym-Trinitrobenzene		50
Aroclor 1016	SW-846 Method 8082	1

Table A-1. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (μg/L)
Aroclor 1221		1
Aroclor 1232		1
Aroclor 1242		1
Aroclor 1248		1
Aroclor 1254		1
Aroclor 1260		1

Note: The analytical methods and highest allowable PQLs provided in this table do not represent EPA or Washington State Department of Ecology requirements but are intended solely as guidance.

a. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*. Equivalent methods may be substituted.

b. For purposes of this groundwater monitoring plan, the highest allowable PQL is interchangeable with the lower limit of quantitation, which is the lowest level that can be routinely quantified and reported by a laboratory. The highest allowable PQLs are not to be exceeded and are specified in contracts with analytical laboratories. Actual quantitation limits vary by laboratory and may be lower than required contractually. MDLs are three to five times lower than quantitation limits.

c. General Chemistry Analyses: Dilutions for certain ion chromatography constituents may be necessary, potentially raising the PQL above the limits established in this table. In circumstances where the PQL, is critical to a project, Sample Management and Reporting will negotiate with the project scientist regarding project specific requirements.

d. General Chemistry Analyses: MDLs and PQLs are not strictly determinable. The highest allowable PQLs represent the lowest concentrations laboratories should be able to measure given current analytical methods and instrumentation.

e. Constituent concentration is calculated from alkalinity and does not have an individual practical quantitation limit.

f. PQL provided for phenol (Chemical Abstracts Service No. 108-95-2). Other PQL values may apply to other phenolic compounds.

EPA = U.S. Environmental Protection Agency

MDL = method detection limit

N/A = not applicable

PQL = practical quantitation limit

Table A-2. Quality Control Samples

Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Field Duplicates	1 in 20 well trips	Precision, including sampling and analytical variability
Field Splits	As needed When needed, the minimum is one for every analytical method, for analyses performed	Precision, including sampling, analytical, and interlaboratory
Full Trip Blanks	1 in 20 well trips	Cross-contamination from containers or transportation

Table A-2. Quality Control Samples

Sample Type	Frequency	Characteristics Evaluated
Field Transfer Blanks	1 each day volatile organic compounds are sampled	Contamination from sampling site
Equipment Blanks	As needed If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment blank is not required Otherwise, 1 for every 20 samples[a]	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Analytical Quality Control[b]		
Laboratory Duplicates	1 per analytical batch[c]	Laboratory reproducibility and precision
Matrix Spikes	1 per analytical batch[c]	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	1 per analytical batch[c]	Laboratory accuracy and precision
Laboratory Control Samples	1 per analytical batch[c]	Laboratory accuracy
Method Blanks	1 per analytical batch[c]	Laboratory contamination
Surrogates	Added to each sample and quality control sample[c]	Recovery/yield

Note: The information in this table does not represent U.S. Environmental Protection Agency or Washington State Department of Ecology requirements but is intended solely as guidance.

a. For portable pumps, equipment blanks are collected one for every 10 well trips. Whenever a new type of nondedicated equipment is used, an equipment blank will be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination methods for the nondedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., all Hanford Site groundwater).

c. Unless not required by, or different frequency is called out in, laboratory analysis methods.

Table A-3. Field and Laboratory Quality Control Elements and Acceptance Criteria

Analysis	Quality Control Element	Acceptance Criteria	Corrective Action
General Chemical Analyses			
Alkalinity (Includes Bicarbonate Alkalinity)	MB	<MDL <5% Sample Concentration	Flag with “C”
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with “N”
	EB, FTB	<2 times MDL	Flag with “Q”

Table A-3. Field and Laboratory Quality Control Elements and Acceptance Criteria

Analysis	Quality Control Element	Acceptance Criteria	Corrective Action
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Total Organic Carbon	MB	<MDL <5% Sample Concentration	Flag with “C”
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with “N”
	EB, FTB	<2 times MDL	Flag with “Q”
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Total Organic Halogen	MB	<MDL <5% Sample Concentration	Flag with “C”
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with “N”
	EB, FTB	<2 times MDL	Flag with “Q”
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Anions			
Anions by Ion Chromatography	MB	<MDL <5% Sample Concentration	Flag with “C”
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with “N”
	EB, FTB	<2 times MDL	Flag with “Q”
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Cyanide	MB	<MDL <5% Sample Concentration	Flag with “C”
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with “N”

Table A-3. Field and Laboratory Quality Control Elements and Acceptance Criteria

Analysis	Quality Control Element	Acceptance Criteria	Corrective Action
	EB, FTB	<2 times MDL	Flag with "Q"
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Sulfide	MB	<MDL <5% Sample Concentration	Flag with "C"
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with "N"
	EB, FTB	<2 times MDL	Flag with "Q"
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Metals			
Inductively Coupled Plasma-Atomic Emission Spectrometry	MB	<MDL <5% Sample Concentration	Flag with "C"
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with "N"
	EB, FTB	<2 times MDL	Flag with "Q"
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Mercury by Cold-Vapor Atomic Absorption	MB	< MDL < 5% Sample Concentration	Flag with "C"
	LCS	80-120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤ 20% RPD	Review Data[a]
	MS/MSD[c]	75-125% Recovery	Flag with "N"
	EB, FTB	<2 × MDL	Flag with "Q"
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Volatile Organic Compounds			
Volatile Organics by GC-MS	MB	<MDL <5% Sample Concentration	Flag with "B"
	LCS	70 to 130% Recovery	Review Data[a]

Table A-3. Field and Laboratory Quality Control Elements and Acceptance Criteria

Analysis	Quality Control Element	Acceptance Criteria	Corrective Action
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	70 to 130% Recovery	Flag with "T"
	SUR	70 to 130% Recovery	Review Data[a]
	EB, FTB, Field Transfer Blank	<2 times MDL[d]	Flag with "Q"
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Semivolatile Organic Compounds			
Polychlorinated biphenyls by GC	MB	<MDL <5% Sample Concentration	Flag with "B"
	LCS	70-130% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	% Recovery Statistically Derived[e]	Flag with "N"
	SUR	70-130% Recovery	Review Data[a]
	EB, FTB	<2 × MDL	Flag with "Q"
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]
Semivolatile Organics by GC-MS (Including Phenols)	MB	<MDL <5% Sample Concentration	Flag with "B"
	LCS	70-130% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	% Recovery Statistically Derived	Flag with "T"
	SUR	70-130% Recovery	Review Data[a]
	EB, FTB	<2 times MDL[d]	Flag with "Q"
	Field Duplicate/Field Splits	≤20% RPD[b]	Review Data[a]

Notes: The information in this table does not represent U.S. Environmental Protection Agency or Washington State Department of Ecology requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, temperature, and turbidity are not listed because they are measured in the field.

a. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect (Y flag) or rejected (R flag).

b. Applies when at least one result is greater than the laboratory PQL (chemical analyses) or greater than five times the MDL.

c. Either a sample duplicate or a matrix spike duplicate is to be analyzed to determine measurement precision.

Table A-3. Field and Laboratory Quality Control Elements and Acceptance Criteria

Analysis	Quality Control Element	Acceptance Criteria	Corrective Action

d. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is <5 times the MDL.

e. Laboratory-determined, statistically derived control limits based on historical data are used here. Control limits are reported with the data.

DUP = laboratory sample duplicate
EB = equipment blank
FTB = full trip blank
GC = gas chromatography
GC-MS = gas chromatography-mass spectrometry
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
N/A = not applicable
RPD = relative percent difference
SUR = surrogate

Data Flags

B, C = possible laboratory contamination: analyte was detected in the associated method blank
N = result may be biased: associated matrix spike result was outside the acceptance limits
Q = problem with associated field quality control blank: results were out of limits
T = result may be biased: associated matrix spike result was outside the acceptance limits (GC-MS only)

Table A-4. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses

Constituent/ Parameter	Minimum Volume[a]	Container Type[b]	Preservation[c]	Holding Time
Alkalinity (Includes Bicarbonate Alkalinity)	500 mL	Narrow mouth poly or glass	Store ≤6°C	14 days
Total Organic Carbon	250 mL	Narrow mouth amber glass with Teflon® lined lid	Store ≤6°C, adjust pH to <2 with sulfuric acid or hydrochloric acid	28 days
Total Organic Halogen	1 L	Narrow mouth glass with Teflon lined lid	Store ≤6°C, adjust pH to <2 with sulfuric acid	28 days
Anions by Ion Chromatography	500 mL	Narrow mouth poly	Store ≤6°C	48 hours
Cyanide	250 mL	Narrow mouth poly or glass	Store ≤6°C, Adjust pH to >12 with 50% NaOH	14 days
Sulfide	3 × 500 mL	Wide mouth poly of glass	Store ≤ 6oC, ZnAc+NaOH to pH > 9	7 days

Table A-4. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses

Constituent/ Parameter	Minimum Volume[a]	Container Type[b]	Preservation[c]	Holding Time
Metals by Inductively Coupled Plasma-Atomic Emission Spectrometry	500 mL	Narrow mouth poly or glass	Adjust pH to <2 with nitric acid	6 months
Mercury by Cold-Vapor Atomic Absorption	500 mL	Narrow mouth glass	Adjust pH to <2 with nitric acid	28 days
Volatiles by GC-MS	1 × 40 mL	Amber glass volatile organic analysis vial	Store ≤6°C, adjust pH to <2 with sulfuric acid or hydrochloric acid	14 days
Polychlorinated Biphenyls by GC	4 × 1 L	Narrow Mouth amber glass with Teflon lined lid	Store <6°C	1 year
Semivolatiles by GC-MS (Including Phenols)	4 × 1 L	Narrow mouth amber glass with Teflon lined lid	Store ≤6°C	7 days before extraction 40 days after extraction

Notes: Teflon is a registered trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.

Information in this table does not represent EPA or Washington State Department of Ecology requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, temperature, and turbidity are not listed because they are measured in the field.

a. Minimum volume provided is that volume required to run a sample with full quality control.

b. The term poly stands for EPA clean polyethylene bottles.

c. For preservation identified as stored at ≤6°C, the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

EPA = U.S. Environmental Protection Agency

GC = gas chromatography

GC-MS = gas chromatography-mass spectrometry

GPC = gas proportional counting

N/A = not applicable

A2 References

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=2cd7465519114fb3472b4864a0e3c42b&node=pt40.26.265&rgn=div5.

265.92, "Sampling and Analysis."

265.93, "Preparation, Evaluation, and Response."

265.94, "Recordkeeping and Reporting."

DOE/RL-2008-58, 2015, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*, Draft Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0079138.

EPA/600/R-93/100, 1993, *Methods for the Determination of Inorganic Substances in Environmental Samples*, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: http://monitoringprotocols.pbworks.com/f/EPA600-R-63-100.pdf.

SW-846, 2015, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

Appendix B

Well Construction

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Contents

Figures

Tables

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B1 Introduction

This appendix provides the following information for the 216-A-29 Ditch groundwater quality assessment monitoring wells:

- Well name
- Hydrogeologic unit to be monitored – the portion of the aquifer that is located at the well screen or perforated casing (Table B-1)
- The following sampling interval information, as shown in Table B-2:
  - Elevation at top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between elevations of top and bottom of the screen or perforated interval)

Figures B-1 through B-10 provide the well construction and completion summaries for 299-E25-2, 299-E25-26, 299-E25-28, 299-E25-32P, 299-E25-34, 299-E25-35, 299-E25-48, 299-E26-12, 299-E26-13, and 699-43-45.

Table B-1. Hydrogeologic Monitoring Unit Classification Scheme

Unit	Description
TU	**Top of Unconfined.** Screened across the water table or the top of the open interval is within 1.5 m (5 ft) of the water table, and the bottom of the open interval is no more than 10.7 m (35 ft) below the water table.
LU	**Lower Unconfined.** Open interval begins at greater than 15.2 m (50 ft) below the water table and below the middle coarse hydrogeologic unit or within 15.2 m (50 ft) of the top of basalt and does not extend more than 3 m (10 ft) below the top of basalt.

Table B-2. Sampling Interval Information for Wells within the 216-A-29 Ditch Network

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation Top of Open Interval m (ft) NAVD88	Elevation Bottom of Open Interval m (ft) NAVD88	Open Interval Length m (ft)
299-E25-2	TU	122.2 (401.1)	110.1 (361.1)	12.2 (40.0)
299-E25-26	TU	122.5 (401.9)	116.4 (381.9)	6.1 (20.0)
299-E25-28	LU	104.82 (343.91)	98.73 (323.9)	6.1 (20.0)
299-E25-32P	TU	125.3 (411.0)	119.3 (391.3)	6.1 (20.0)
299-E25-34	TU	125.7 (412.6)	119.6 (392.3)	6.1 (20.0)
299-E25-35	TU	126.2 (414.0)	119.9 (393.5)	6.3 (20.7)
299-E25-48	TU	124.67 (409.0)	118.27 (388.0)	6.4 (20.9)
299-E26-12	TU	125.81 (412.8)	119.41 (391.8)	6.4 (20.9)

Table B-2. Sampling Interval Information for Wells within the 216-A-29 Ditch Network

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation Top of Open Interval m (ft) NAVD88	Elevation Bottom of Open Interval m (ft) NAVD88	Open Interval Length m (ft)
299-E26-13	TU	126.0 (413.2)	119.7 (392.6)	6.3 (20.6)
699-43-45	TU	126.47 (414.9)	120.37 (394.9)	6.1 (20.0)

Reference: NAVD88, *North American Vertical Datum of 1988*.

TU = Top of Unconfined (as described in Table C-1)

B2 Reference

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

WELL CONSTRUCTION AND COMPLETION SUMMARY

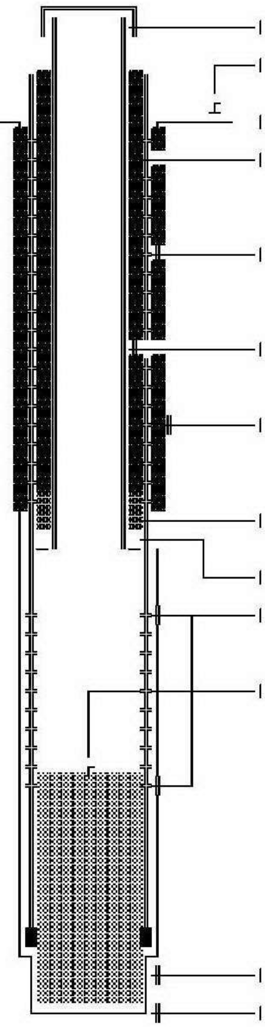
Drilling Method: Cable tool	Sample Method: Hard tool (nom)	WELL NUMBER: 299-E25-2 / TEMPORARY WELL NO: 216-A-1 #6
Drilling Fluid Used: Water	Additives Used: Not documented	Hanford Coordinates: N/S N 41,265.5 E/W W 47,175.1
Driller's Name: Row/Richards	WA State Lic Nr: Not documented	State NAD83 N 136,062.2m E 575,514.0m
Drilling Company: Not documented	Company Location: Not documented	Coordinates: N 446,446 E 2,248,044
Date Started: 03Feb54	Date Complete: 15Mar55	Start Card #: Not documented T___ R___ S___
		Elevation Ground surface: 673.6-ft Estimated

Depth to water: 286-ft Mar55
(Ground surface) 271.3-ft 24Jun93

GENERALIZED STRATIGRAPHY — Driller's Log

0-10: TOP SOIL and SAND
10-30: Sandy SILT
30-33: SAND and GRAVEL
33-50: Sandy SILT
50-60: SAND, SILT
60-85: Sandy SILT
85-115: SAND, SILT
115-122: GRAVEL
122-135: Sandy SILT
135-205: SAND and SILT
205-210: GRAVEL
210-260: GRAVEL, SAND
260-270: SILT, SAND
270-275: GRAVEL and SILT
275-290: GRAVEL
290-315: GRAVEL and SAND
315-320: SAND
320-330: GRAVEL and SAND
330-335: GRAVEL
335-340: GRAVEL, SAND
340-356: GRAVEL, SAND, SILT
356-365: GRAVEL, SAND, MUD
365-375: BASALT

REMEDIATION:
Jan82, by David Garcia?
Perforated 0-235-ft.
Set 6-in liner to 239-ft.
Poured 10-gals of fine sand, then 18-gals of cement and checked for leaks. Completed with 200-gals of thin grout.



Elevation of reference point: (top of casing) [675.45-ft]
Height of reference point above ground surface [1.9-ft]
Depth of surface seal [0-235-ft]
Type of surface seal: Cement grout between 6-in liner and 8-in (perforated) casing
8-in ID carbon steel casing, +~1-364-ft
Perforated during remediation, 0-235-ft, 2 cuts/ft
6-in ID carbon steel liner, +1.9-ft-240-ft
Hole diameter, 9-in nominal 0-364-ft
Sand plug ~230-240-ft
Packer set: @ 240-ft
8-in casing perforations, 0-235-ft, 2 cuts/ft 276-316-ft, 4 holes/ft
Interval shortened, 14Mar90 Added 14-sacks sand DTB=~316-ft.
Hole diameter, 8-in nominal 364-375-ft
Borehole drilled depth: [375-ft]

Drawing By: RKL/2E25-02.ASB
Date : 03Sep93
Reference : HANFORD WELLS

Figure B-1. Well 299-E25-2 Construction and Completion Summary

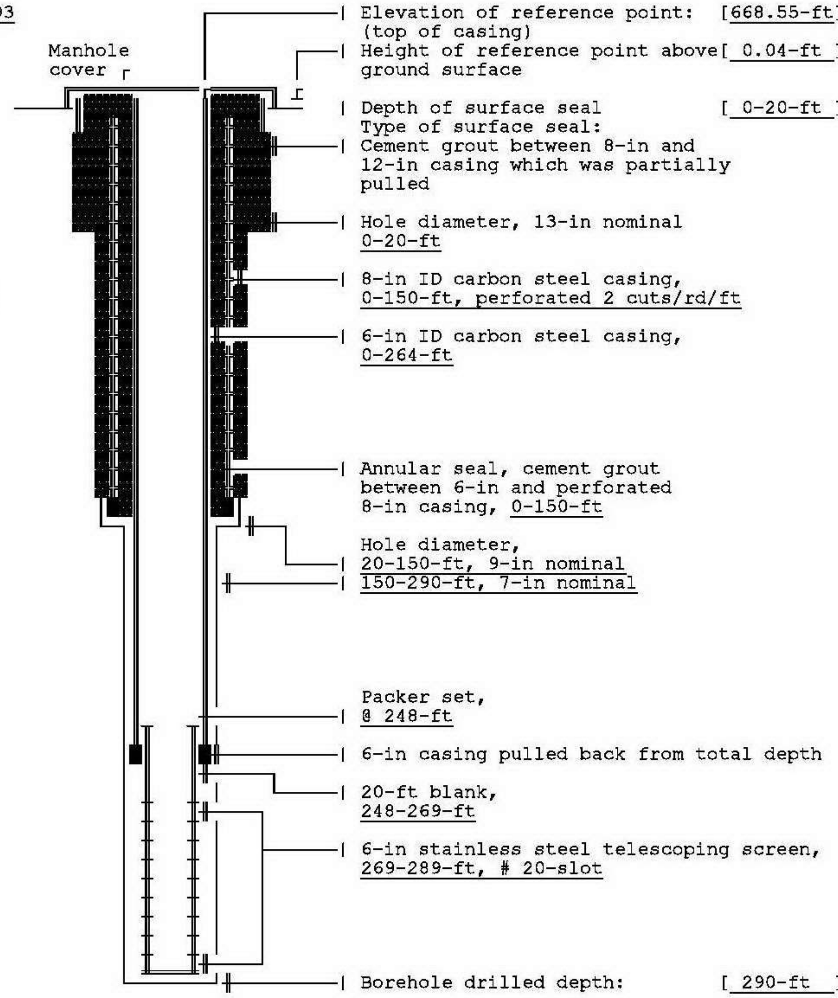
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Hard tool (nom)	WELL NUMBER: 299-E25-26 — TEMPORARY WELL NO:
Drilling Fluid Used: Water	Additives Used: Not documented	Hanford Coordinates: N/S N 40,773 E/W W 45,884
Driller's Name: J. Bultena	WA State Lic Nr: 0066	State Coordinates: N 445,957 E 2,249,336
Drilling Company: Onwego Drilling	Company Location: Kennewick, WA	Start Card #: Not documented T R S
Date Started: 01Mar85	Date Complete: 11Apr85	Elevation Ground surface: 668.51-ft Brass cap

Depth to water: 264-ft Apr85
(Ground surface) 266.1-ft 22Jun93

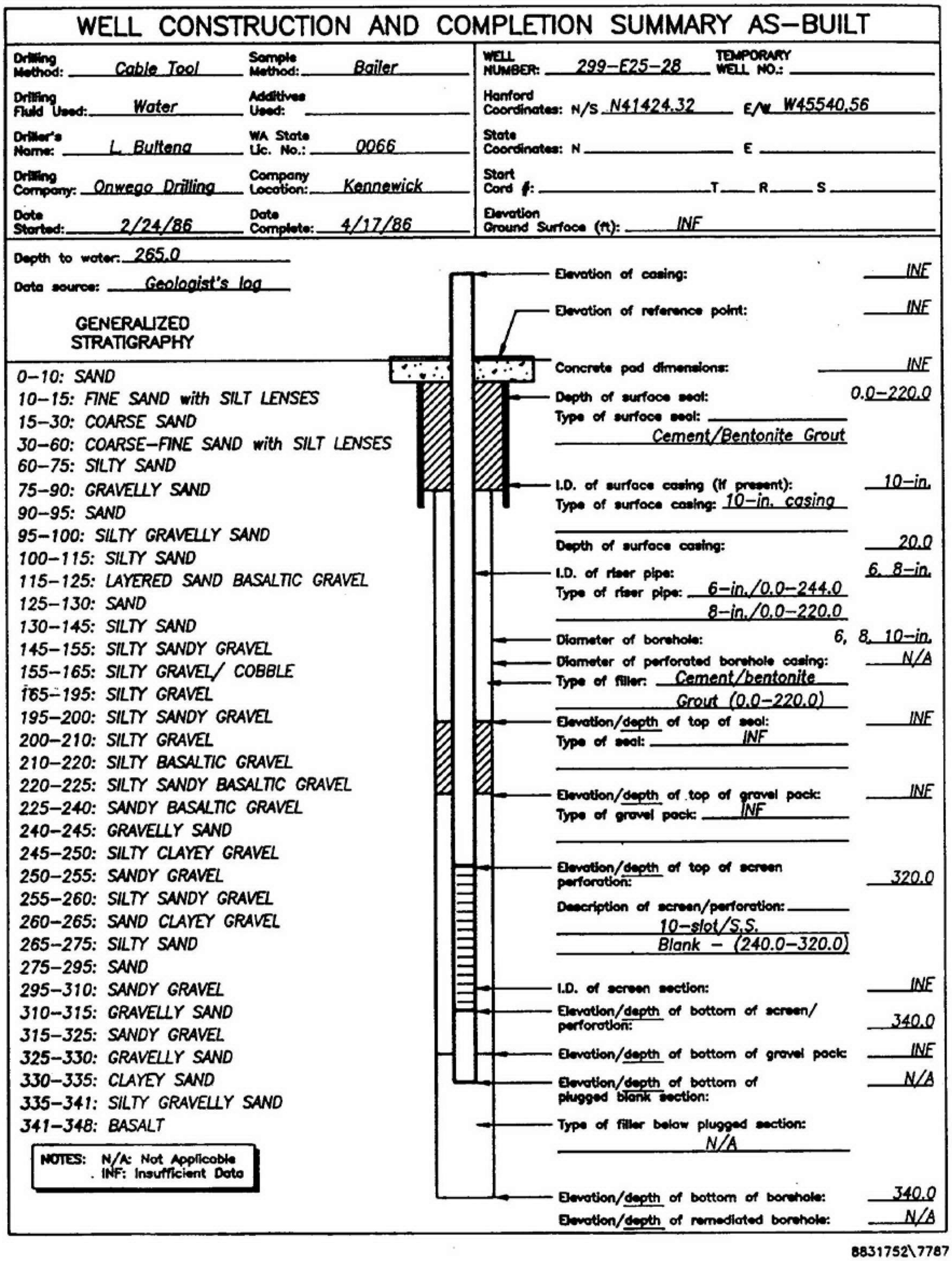
GENERALIZED STRATIGRAPHY — Geologist's Log

0-5: Silty SAND
5-10: Gravelly SAND
10-15: Silty SAND
15-20: Gravelly silty SAND
23-40: Gravelly SAND
40-65: SAND
65-75: SAND, SILT lenses
75-100: Gravelly SAND
100-103: SAND
103-105: Silty CLAY, silty SAND
105-110: SAND
110-130: SAND SILT CLAY lenses
130-150: SAND
150-160: Gravelly SAND
160-175: Sandy GRAVEL
175-195: Gravelly SAND
195-205: Sandy GRAVEL
205-240: Sandy GRAVEL, COBBLES
240-245: Sandy GRAVEL
245-255: Silty sandy GRAVEL
255-260: Gravelly silty SAND
260-285: Silty gravelly SAND
285-290: Silty SAND



Drawing By: RKL/2E25-26.ASB
Date : 07Sep93
Reference : HANFORD WELLS

Figure B-2. Well 299-E25-26 Construction and Completion Summary



WELL CONSTRUCTION AND COMPLETION SUMMARY AS-BUILT

Drilling Method: Cable Tool	Sample Method: Bailer	WELL NUMBER: 299-E25-28	TEMPORARY WELL NO.:
Drilling Fluid Used: Water	Additives Used:	Hanford Coordinates: N/S N41424.32	E/W W45540.56
Driller's Name: L. Bultena	WA State Lic. No.: 0066	State Coordinates: N	E
Drilling Company: Onwego Drilling	Company Location: Kennewick	Start Card #:	T R S
Date Started: 2/24/86	Date Complete: 4/17/86	Elevation Ground Surface (ft): INF	

Depth to water: 265.0

Data source: Geologist's log

GENERALIZED STRATIGRAPHY

0–10: SAND
10–15: FINE SAND with SILT LENSES
15–30: COARSE SAND
30–60: COARSE–FINE SAND with SILT LENSES
60–75: SILTY SAND
75–90: GRAVELLY SAND
90–95: SAND
95–100: SILTY GRAVELLY SAND
100–115: SILTY SAND
115–125: LAYERED SAND BASALTIC GRAVEL
125–130: SAND
130–145: SILTY SAND
145–155: SILTY SANDY GRAVEL
155–165: SILTY GRAVEL/ COBBLE
165–195: SILTY GRAVEL
195–200: SILTY SANDY GRAVEL
200–210: SILTY GRAVEL
210–220: SILTY BASALTIC GRAVEL
220–225: SILTY SANDY BASALTIC GRAVEL
225–240: SANDY BASALTIC GRAVEL
240–245: GRAVELLY SAND
245–250: SILTY CLAYEY GRAVEL
250–255: SANDY GRAVEL
255–260: SILTY SANDY GRAVEL
260–265: SAND CLAYEY GRAVEL
265–275: SILTY SAND
275–295: SAND
295–310: SANDY GRAVEL
310–315: GRAVELLY SAND
315–325: SANDY GRAVEL
325–330: GRAVELLY SAND
330–335: CLAYEY SAND
335–341: SILTY GRAVELLY SAND
341–348: BASALT

NOTES: N/A: Not Applicable
INF: Insufficient Data

Elevation of casing: INF
Elevation of reference point: INF
Concrete pad dimensions: INF
Depth of surface seal: 0.0–220.0
Type of surface seal: Cement/Bentonite Grout
I.D. of surface casing (if present): 10–in.
Type of surface casing: 10–in. casing
Depth of surface casing: 20.0
I.D. of riser pipe: 6, 8–in.
Type of riser pipe: 6–in./0.0–244.0
8–in./0.0–220.0
Diameter of borehole: 6, 8, 10–in.
Diameter of perforated borehole casing: N/A
Type of filler: Cement/bentonite Grout (0.0–220.0)
Elevation/depth of top of seal: INF
Type of seal: INF
Elevation/depth of top of gravel pack: INF
Type of gravel pack: INF
Elevation/depth of top of screen perforation: 320.0
Description of screen/perforation: 10–slot/S.S.
Blank – (240.0–320.0)
I.D. of screen section: INF
Elevation/depth of bottom of screen/perforation: 340.0
Elevation/depth of bottom of gravel pack: INF
Elevation/depth of bottom of plugged blank section: N/A
Type of filler below plugged section: N/A
Elevation/depth of bottom of borehole: 340.0
Elevation/depth of remediated borehole: N/A

8831752\7787

Figure B-3. Well 299-E25-28 Construction and Completion Summary

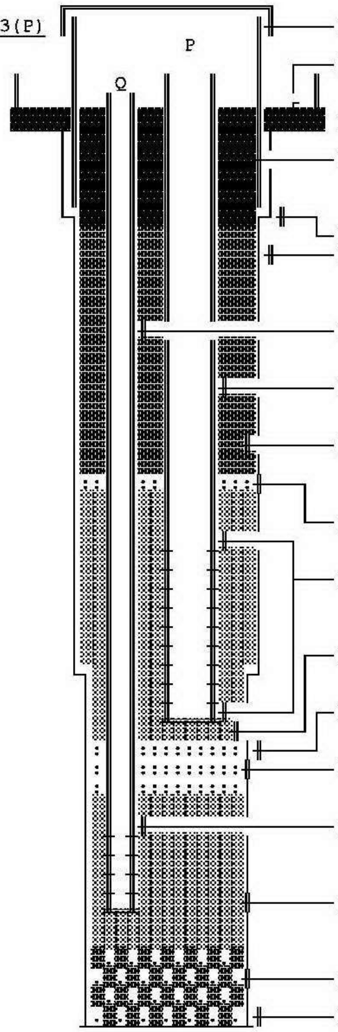
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E25-32 TEMPORARY WELL NO:
Drilling Fluid Used: 200E Area Water	Additives Used: Not documented	Hanford Coordinates: N/S N 41,199.2 E/W W 44,325.4
Driller's Name: O. Amos	WA State Lic Nr: 1224	State Coordinates: N 446,387 E 2,250,894
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T R S
Date Started: 12Nov87	Date Complete: 27Jun88	Elevation Ground surface: 668.07-ft Brass cap

Depth to water: 264-ft Jun88
(Ground surface) 266.5-ft 22Jun93(P)

GENERALIZED STRATIGRAPHY Geologist's Log

0-5: Not documented
10-30: Silty gravelly SAND
10-35: SAND
35-45: Silty SAND
45-50: SAND
50-60: Gravelly SAND
60-65: Silty SAND
65-80: SAND
80-90: Silty SAND
90-95: SAND
95-110: Silty SAND
110-140: Silty gravelly SAND
140-145: Silty SAND
145-155: SAND
155-160: Gravelly silty SAND
160-180: Silty sandy GRAVEL
180-185: Sandy GRAVEL
185-235: Silty sandy GRAVEL
235-245: Gravelly silty SAND
245-285: Silty sandy GRAVEL
285-295: Gravelly silty SAND
295-300: GRAVEL
300-305: Sandy GRAVEL
305-350: Silty sandy GRAVEL
350-354: BASALT flowtop



Elevation of reference point: [670.38-ft]
(top of 12-in casing)
Height of reference point above ground surface [2.3-ft]
Depth of surface seal [0-12-ft]
Type of surface seal:
Cement grout to 12-ft
4 x 4-ft x 4-in concrete pad
Hole diameter,
0-13-ft, 13-in nominal
12-270-ft, 11-in nominal
2-in ID T304 stainless steel tubing,
+0.6-320-ft (Q)
4-in ID T304 stainless steel casing,
+1.1-259.4-ft (P)
Powdered bentonite,
12-251-ft
Granular bentonite,
251-253-ft
4-in stainless steel screen,
259.4-279.4-ft, #20-slot
Sandpack,
253-284.8-ft
Hole diameter, 9-in nominal,
270-354-ft
Granular bentonite, tremmied "EnViroGel"
284.8-310.5-ft
2-in T304 stainless steel screen,
320-330.6-ft, #20-slot
Sandpack,
310.5-338-ft
Bentontie/sand slurry,
338-354-ft
Borehole drilled depth: [354-ft]

Drawing By: RKL/2E25-32.ASB
Date : 08Sep93
Reference : HANFORD WELLS

Figure B-4. Well 299-E25-32P Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

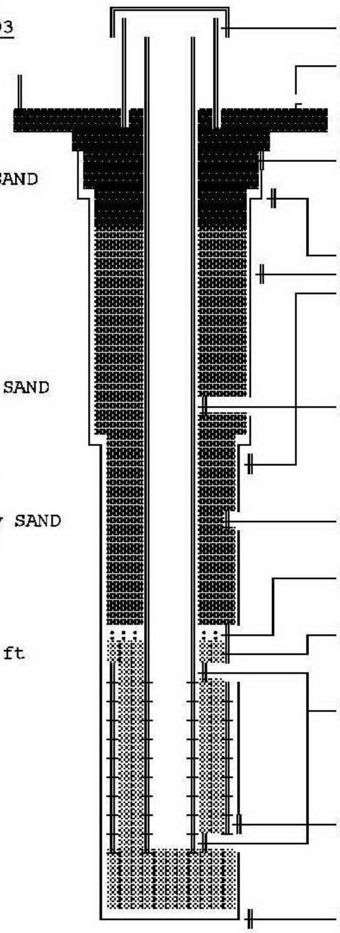
Drilling Method: Cable tool	Sample Method: Drive barrel
Drilling Fluid Used: 200E Area Water	Additives Used: Not documented
Driller's Name: Cordon/Garcia/Murphy	WA State Lic Nr: 1143 (Garcia)
Drilling Company: Kaiser Engineers	Company Location: Hanford
Date Started: 03Jun88	Date Complete: 19Sep88

WELL NUMBER: 299-E25-34	TEMPORARY WELL NO:
Hanford Coordinates: N/S N 41,386	E/W W 45,517
State Coordinates: N 446,571	E 2,249,702
Start Card #: 007916	T 26E R 12N S 1
Elevation Ground surface: 660.62-ft (Brass cap)	

Depth to water: 254.5-ft Sep88
(Ground surface) 258.2-ft 22Jun93

GENERALIZED Geologist's
STRATIGRAPHY Log

0-10: Silty SAND
10-15: Silty sandy GRAVEL
15-20: Slightly silty gravelly SAND
20-30: Slightly gravelly slightly silty SAND
30-35: Slightly gravelly SAND
35-40: Silty SAND
40-55: SAND
55-65: Silty SAND
65-75: SAND
75-80: Gravelly SAND
80-85: Silty sandy GRAVEL
85-90: Gravelly silty SAND
90-100: Slightly silty gravelly SAND
100-105: Slightly gravelly slightly silty SAND
105-110: Gravelly SAND
110-115: SAND
115-120: Slightly gravelly SAND
120-125: Gravelly silty SAND
125-140: Slightly silty gravelly SAND
140-145: SAND
145-150: Slightly gravelly SAND
150-155: Gravelly SAND
155-180: Sandy GRAVEL
180-185: Silty sandy GRAVEL
185-195: Sandy GRAVEL
195-200: Apparent BOULDER @ 195 ft
200-210: Sandy GRAVEL
210-215: Silty sandy GRAVEL
215-225: Sandy GRAVEL
225-230: Gravelly SAND
230-245: Sandy GRAVEL
245-250: Gravelly SAND
250-255: Sandy GRAVEL
255-260: SAND
260-265: Silty sandy GRAVEL
265-270: SAND
270-275: Sandy GRAVEL
275-TD : Gravelly SAND



Elevation of reference point: [662.87-ft] (top of casing)
Height of reference point above ground surface [2.25-ft]
Depth of surface seal [2.2-20.1-ft]
Type of surface seal:
Cement grout, 2.2-20.1-ft
4x4-ft x 4-in concrete pad extending 2.2-ft into annulus

Hole diameter,
0-10-ft, 13-in nominal
10-162.5-ft, 11-in nominal
162.5-276.0-ft, 9-in nominal

4-in ID T304 stainless steel casing, +ND-251.6-ft

Granular/powdered bentonite, 20.1-250.3-ft

╝-in Enviroplug bentonite pellets, 250.3-251-ft

Silica sand pack, 251-276-ft, 6-30-mesh

4-in T304 stainless steel screen, 251.6-271.6-ft, #20-slot

8-in T304 stainless steel telescoping screen, 251.6-271.6-ft

Borehole drilled depth: [276.0-ft]

Drawing By: RKL/2E25-34.ASB
Date : 08Sep93
Reference : HANFORD WELLS

Figure B-5. Well 299-E25-34 Construction and Completion Summary

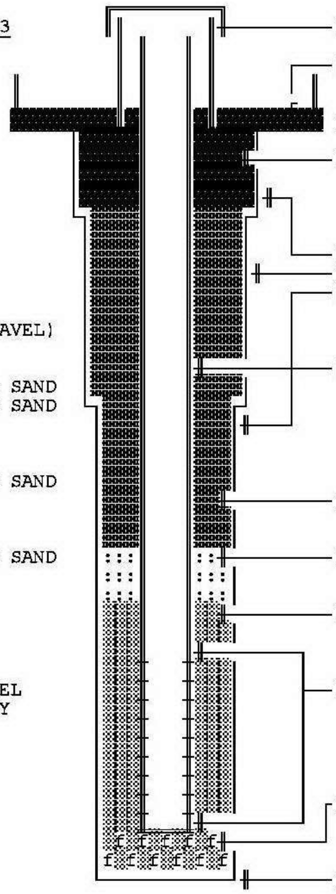
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Not documented	WELL NUMBER: 299-E25-35
Drilling Fluid Used: 200E Area Water	Additives Used: Not documented	TEMPORARY WELL NO:
Driller's Name: Amos/Wamsley	WA State Lic Nr: 1224 (Amos)	Hanford Coordinates: N/S N 40,616.7 E/W W 46,538.5
Drilling Company: Kaiser Engineers	Company Location: Hanford	State Coordinates: N 445,799 E 2,248,682
Date Started: 03May88	Date Complete: 27Aug88	Start Card #: Not documented T___ R___ S___
		Elevation Ground surface: 670.98-ft (Brass cap)

Depth to water: 264.3-ft Aug88
(Ground surface) 268.9-ft 22Jun93

GENERALIZED Geologist's
STRATIGRAPHY Log

0-10: Slightly silty SAND
10-15 Silty SAND
15-20: Sandy GRAVEL
20-30: Silty sandy GRAVEL
30-55: SAND
55-60: Silty gravelly SAND
60-75: Gravelly SAND
75-85: Sandy GRAVEL
85-100: Slightly gravelly SAND
100-115: Gravelly SAND
115-120: SAND (Note: 116-119: GRAVEL)
120-125: Silty SAND
125-130: Gravelly SAND
130-135: Slightly gravelly silty SAND
135-160: Slightly silty gravelly SAND
160-165: Slightly silty SAND
165-170: Slightly silty slightly gravelly SAND
170-175: Slightly silty gravelly SAND
175-185: Silty sandy GRAVEL
185-190: Slightly silty slightly gravelly SAND
190-210: Slightly silty gravelly SAND
210-220: Silty sandy GRAVEL
220-235: Sandy GRAVEL
235-240: Slightly silty SAND
240-245: Silty sandy GRAVEL
245-250: Gravelly SAND
250-255: Silty sandy GRAVEL
255-260: Silty/clayey sandy GRAVEL
260-265: Gravelly sandy SILT/CLAY
265-270: CLAY/SILT
270-275: Slighlty gravelly slightly silty SAND
275-280: Slightly gravelly SAND
280-285: SAND



Elevation of reference point: [674.39-ft]
(top of casing)
Height of reference point above ground surface [3.4-ft]
Depth of surface seal [3-19.5-ft]
Type of surface seal:
Cement grout 3-19.5-ft
4x4-ft x 4-in concrete pad extends 3.0-ft into annulus
Hole diameter,
3.0-20.2-ft, 13-in nominal
20.2-145.3-ft, 11-in nominal
145.3-285-ft, 9-in nominal
4-in ID T304 stainless steel casing, +ND-260.5-ft
Bentonite crumbles, 19.5-250.9-ft
Bentonite pellets, 250.9-256.2-ft
Silica sand pack, 256.2-~281.0-ft, 10-20-mesh
4-in stainless steel screen, 260.5-281.0-ft, #20-slot
Fill, ~281-285.0-ft
Borehole drilled depth: [285.0-ft]

Drawing By: RKL/2E25-35.ASB
Date : 08Sep93
Reference : HANFORD WELLS

Figure B-6. Well 299-E25-35 Construction and Completion Summary

A4795 / 299-E25-48

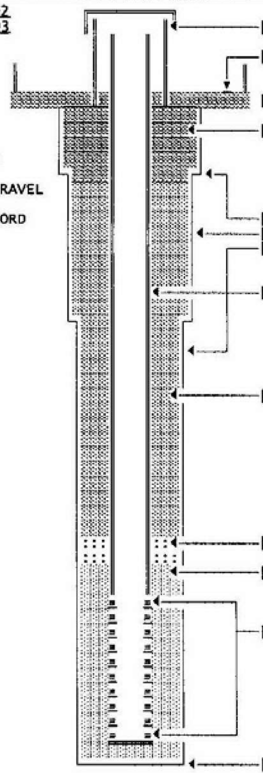
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Downhole hammer Backhoe/Air rotary	Sample Method: Air returns Continous	WELL NUMBER: 299-E25-48
Drilling Fluid Used: None	Additives Used: None documented	TEMPORARY WELL NO:
Driller's Name: D. Mingo	WA State Lic Nr: Not documented	Hanford Coordinates: N/S N 40,456.8 E/W W 46,816.1
Drilling Company: Jensen Drilling Co	Company Location: Not documented	State NAD83 Coordinates: N 135,815.16m 575,623.43m; N 445,638 E 2,248,405
Date Started: 01Jul92	Date Complete: 01Oct92	Start Card #: Not documented T___ R___ S___
		Elevation Ground surface: 679.68-ft (Brass cap)

Depth to water: 276.3-ft 25Aug92
(Ground surface) 277.0-ft 22Jun93

GENERALIZED Geologist's STRATIGRAPHY Log

0↔20: SAND
20↔30: Gravelly (pebbly) SAND
30↔40: Sandy (pebble) GRAVEL
40↔50: Sl gravelly (pebbly) SAND
50↔60: Sandy (pebble) GRAVEL
60↔75: Sl silty sandy (pebble) GRAVEL
75↔85: (Pebble) GRAVEL
HANFORD Upper coarse/HANFORD Fine contact @85-ft
85↔90: (Pebbly) gravelly SAND
90↔110: Sl silty SAND
110↔202: SAND
202↔208: Silty SAND
208↔220: SAND
220↔225: (Pebbly) gravelly SAND
225↔230: Sandy (cobble) GRAVEL
230↔235: (Pebbly) gravelly SAND
235↔245: SAND
245↔248: Silty SAND
248↔266.5: SAND
HANFORD Fine/RINGOLD contact @ 266.5-ft
266.5↔280: Sandy SILT
280↔285: Sl gravelly SAND
285↔295: Sl sandy GRAVEL
295↔297.5: Sandy GRAVEL



Elevation of reference point: [682.31-ft] (top of casing)
Height of reference point above ground surface [2.63-ft]
Depth of surface seal [2.0↔10.3-ft]
Type of surface seal: Cement grout, 2.0↔10.3-ft
4x4-ft x 4-in concrete pad extends 2.0-ft into annulus
Hole diameter, 2.0↔9.5-ft, 13-in nominal
9.5↔168.8-ft, 11-in nominal
168.8↔297.5-ft, 9-in nominal
4-in ID stainless steel casing, +1.4↔274.3-ft
Bentonite crumbles, 10.3↔262.6-ft, 8↔20-mesh
3/8-in bentonite pellets 262.6↔268.4-ft
Silica sand pack, 268.4↔297.5-ft, 20↔40-mesh
4-in T304 stainless steel screen, 274.3↔294.6-ft, #10-slot w/cap
Borehole drilled depth: [297.5-ft]

Drawing By: RKL/2E25-48.ASB
Date : 08Sep93
Reference : WHC-SD-EN-DP-054

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E25-48

WELL DESIGNATION :	299-E25-48
RCRA FACILITY :	Grout
CERCLA UNIT :	Not applicable
HANFORD COORDINATES :	N 40,456.8 W 46,816.1 [30Dec92-200E]
LAMBERT COORDINATES :	N 445,638 E 2,248,405 [HANCONV]; N 135,815.16m E 575,623.43m [NAD83-30Dec92]
DATE DRILLED :	Oct92
DEPTH DRILLED (GS) :	297.5-ft
MEASURED DEPTH (GS) :	286.1-ft, 03Nov92
DEPTH TO WATER (GS) :	276.3-ft, 25Aug92; 277.0-ft, 22Jun93
CASING DIAMETER :	6-in, stainless steel, +2.6↔-0.5-ft; 4-in, stainless steel, +1.4↔274.3-ft
ELEV TOP CASING :	682.31-ft, [30Dec92-NGVD'29]
ELEV GROUND SURFACE :	679.68-ft, Brass cap [30Dec92-NGVD'29]
PERFORATED INTERVAL :	Not applicable
SCREENED INTERVAL :	274.3↔294.6-ft, 4-in stainless steel, #10-slot
COMMENTS :	FIELD INSPECTION, 03Nov92; 4 and 6-in stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable. Capped and locked, brass cap in pad with well ID. Not in radiation zone.
AVAILABLE LOGS :	Geologist
TV SCAN COMMENTS :	Not applicable
DATE EVALUATED :	Not applicable
EVAL RECOMMENDATION :	Not applicable
LISTED USE :	A-29 Ditch monthly water level measurement, 14Dec92↔22Jun93;
CURRENT USER :	WHC ES&M w/l monitoring and RCRA sampling, PNL sitewide sampling 93
PUMP TYPE :	Hydrostar, intake @ 257.4-ft (GS)
MAINTENANCE :	

Figure B-7. Well 299-E25-48 Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

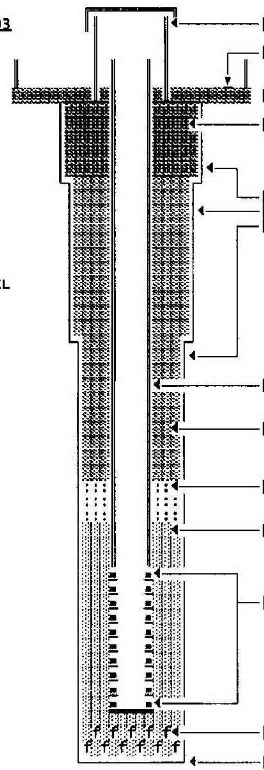
A4801

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E26-12 TEMPORARY WELL NO:
Drilling Fluid Used: None	Additives Used: None	Hanford Coordinates: N/S N 42,313.1 E/W W 44,929.2
Driller's Name: R Thomas/J Carpenter	WA State Lic Nr: Not documented	State NAD83 N 136,383.2m E 576,197.7m; Coordinates: N 447,500 E 2,250,287
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T____ R____ S____
Date Started: 03Jun91	Date Complete: 13Aug91	Elevation Ground surface: 627.27-ft (Brass cap)

Depth to water: 222.5-ft Jul91
(Ground surface) 224.4-ft 22Jun93

GENERALIZED Geologist's
STRATIGRAPHY Log
Sl=slightly

0↔5: Silty gravelly SAND
5↔10: Sl silty sl gravelly SAND
10↔15: Sl silty SAND
15↔30 Silty SAND
30↔45: Sl silty SAND
45↔55: Sl silty gravelly SAND
55↔60: Sl gravelly SAND
60↔65: Sl gravelly silty SAND
65↔85: Sl silty gravelly SAND
85↔95: Sl silty SAND
95↔115: Gravelly SAND
115↔155: Sandy GRAVEL
155↔165: Sl silty sl sandy GRAVEL
165↔170: GRAVEL
170↔180: Sl sandy GRAVEL
180↔185: Sandy GRAVEL
185↔200: Sl sandy GRAVEL
200↔210: Sandy GRAVEL
210↔215: Sl silty sandy GRAVEL
215↔235: Sandy GRAVEL
235↔240: Sl silty sandy GRAVEL
240↔242.2: Sandy GRAVEL



Drawing By: RKL/2E26-12.ASB
Date : 09Sep93
Reference: WHC-SD-EN-DP-047

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E26-12

WELL DESIGNATION	:	299-E26-12
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	A-29 Ditch
HANFORD COORDINATES	:	N 42,313.1 W 44,929.2 [200E-31Oct91]
LAMBERT COORDINATES	:	N 447,500 E 2,250,287 [HANCONV] N 136,383.2m E 576,197.7m [NAD83-20May92]
DATE DRILLED	:	Aug91
DEPTH DRILLED (GS)	:	242.2-ft
MEASURED DEPTH (GS)	:	239.2-ft, 08Apr93
DEPTH TO WATER (GS)	:	222.5-ft, 01Jul91 224.4-ft, 22Jun93
CASING DIAMETER	:	4-in stainless steel, +1.0↔217.6-ft; 6-in stainless steel, +3.47↔~0.5-ft
ELEV TOP CASING	:	630.74-ft, [NGVD'29-31Oct92]
ELEV GROUND SURFACE	:	627.27-ft, Brass cap [NGVD'29-31Oct92]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	217.6↔238.6-ft, 4-in #20-slot stainless steel;
COMMENTS	:	FIELD INSPECTION, 08Apr93; 4 and 6-in stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable. Capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Geologist
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	A-29 Ditch monthly water level measurement, 28Oct91↔22Jun93;
CURRENT USER	:	WHC ES&M w/l monitoring and RCRA sampling, PNL sitewide sampling 93
PUMP TYPE	:	Hydrostar, intake @ 235.5-ft (GS)
MAINTENANCE	:	

Figure B-8. Well 299-E25-12 Construction and Completion Summary

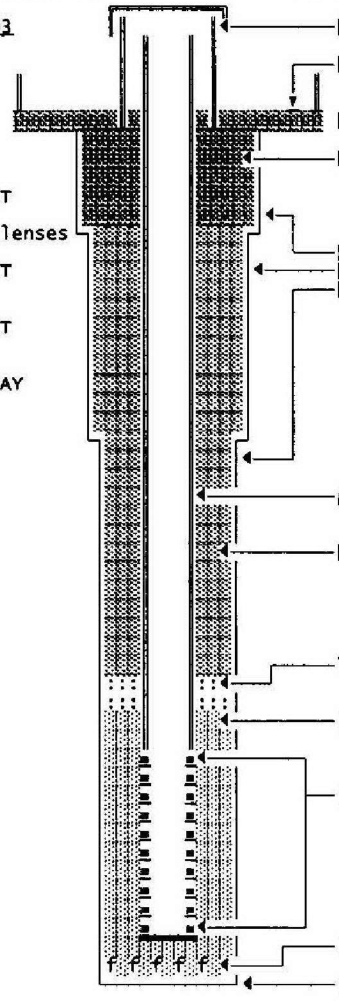
WELL CONSTRUCTION AND COMPLETION SUMMARY A4802

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E26-13 TEMPORARY WELL NO:
Drilling Fluid Used: Raw water	Additives Used: None	Hanford Coordinates: N/S N 42,790.3 E/W W 44,922.6
Driller's Name: K Blackman/B Smith	WA State Lic Nr: Not documented	State NAD83 Coordinates: N 136,528.6m / 447,977 E 576,199.3m / 2,250,293
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T___ R___ S___
Date Started: 03Jun91	Date Complete: 16Aug91	Elevation Ground surface: 601.57-ft (Brass cap)

Depth to water: 197.0-ft Jun91
(Ground surface) 198.8-ft 22Jun93

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0↔15: Sl silty gravelly SAND
15↔20: Sl silty SAND
20↔25: SAND w/trace SILT
25↔40: Gravelly SAND w/trace SILT
40↔45: Silty SAND w/SILT lenses
45↔45: Silty SAND w/GRAVEL-SILT lenses
45↔50: Silty SAND w/GRAVEL
50↔65: Gravelly SAND w/trace SILT
65↔70: SAND
70↔80: Gravelly SAND
80↔90: Gravelly SAND w/trace SILT
90↔140: Sandy GRAVEL
140↔160: Sandy clayey GRAVEL
160↔170: Sandy GRAVEL w/trace CLAY
170↔205: Sandy clayey GRAVEL
205↔210: Sandy GRAVEL
210↔215: Sandy clayey GRAVEL



Drawing By: RKL/2E26-13.ASB
Date: 09Sep93
Reference: WHC-SD-EN-DP-047

Figure B-9. Well 299-E26-13 Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200E Area Water
Driller's Name: L. Watkins
Drilling Company: KEH
Date Started: 02May89

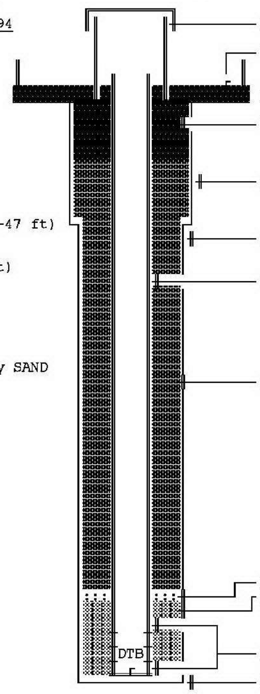
Sample Method: Drive barrel & Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 02Jun89

WELL NUMBER: 699-43-45 A5180 TEMPORARY WELL NO: BP-1
Hanford Coordinates: N/S N 42,977.4 E/W W 44,643.6
State Coordinates: N 448,164.7 E 2,250,571.2
Start Card #: 011453 T 12N R 26E S 1NW
Elevation Ground surface: 594.70-ft Brass cap

Depth to water: 187.7-ft Jun89
(Ground surface) 192.1-ft 22Jul94

GENERALIZED STRATIGRAPHY Geologist's Log

5-10: Muddy SAND
10-15: Gravelly SAND
15-20: SAND (medium)
20-25: Slightly gravelly SAND
25-40: Gravelly SAND
40-43: SAND
43-45: Slightly muddy med to very fine SAND
45-50: Muddy SAND(Perched water-47 ft)
50-60: SAND
60-70: Slightly gravelly SAND
70-85: SAND (COBBLES at 72-73 ft)
85-115: Sandy GRAVEL
115-135: Muddy sandy GRAVEL
135-146: Slightly sandy GRAVEL
146-150: Muddy GRAVEL
150-155: Sandy GRAVEL
155-195: Muddy sandy GRAVEL
195-200: Slightly muddy gravelly SAND
200-203: Gravelly SAND



Elevation of reference point: (top of casing) [597.68-ft]
Height of reference point above ground surface [3.0-ft]
Depth of surface seal [3.4-18.5-ft]
Type of surface seal: Cement grout to 18.5-ft
4 x 4-ft x 4-in concrete pad extends 3.4-ft into annulus
11-in nominal hole, 0-47-ft
9-in nominal hole, 47.0-203.4-ft
4-in ID T304 stainless steel casiing, +0.5-183.0-ft
Granular bentonite, 18.5-173.4-ft
Bentonite pellets, 173.4-179.2-ft
Silica sand pack, 179.2-203.6-ft, 8-20-mesh
4-in T304 stainless steel screen, 183.0-203.3-ft, #20-slot
Borehole drilled depth: [203.6-ft]
DTB=Depth to bottom, 203.9-ft, 08Apr93

Drawing By: RKL/6N43W45.ASB
Date : 22Sep94
Reference : HANFORD WELLS

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 699-43-45

WELL DESIGNATION	:	699-43-45
RCRA FACILITY	:	216-B-3 Pond
CERCLA UNIT	:	Not applicable
HANFORD COORDINATES	:	N 42,977 W 44,644 [28Sep89-200E]
LAMBERT COORDINATES	:	N 448,165 E 2,250,571 [HANCONV] N 136,585.7m E 576,284.2m [28Sep89-NAD83]
DATE DRILLED	:	Jun89
DEPTH DRILLED (GS)	:	203.6-ft
MEASURED DEPTH (GS)	:	203.9-ft, 08Apr93
DEPTH TO WATER (GS)	:	187.7-ft, Jun89, 192.1-ft, 22Jul94
CASING DIAMETER	:	4-in, stainless steel, +0.5-183.0-ft, 6-in, stainless steel, +3.0--0.5-ft
ELEV TOP CASING	:	597.68-ft (6-in) [28Sep89-UNK] 595.2-ft, (4-in) [28Sep89-UNK]
ELEV GROUND SURFACE	:	594.70-ft, Brass cap [28Sep89-UNK]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	183.0-203.3-ft, 4-in stainless steel, #20-slot
COMMENTS	:	FIELD INSPECTION, 08Apr93; 4 and 6-in stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable. Capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER;
AVAILABLE LOGS	:	Geologist, Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	B-Pond monthly water level measurement, 24Oct89-22Jul94,
CURRENT USER	:	WHC ES&M w/l monitoring and RCRA sampling, PNL sitewide w/l monitoring
PUMP TYPE	:	Hydrostar,
MAINTENANCE	:	

Figure B-10. Well 699-43-45 Construction and Completion Summary

Appendix C

DOE/RL-2008-58, Draft Rev. 1

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DOE/RL-2008-58
Draft Rev. 1

Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
Richland, Washington 99352

DOE/RL-2008-58
Draft Rev. 1

Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch

Date Published
October 2015

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY | Richland Operations Office
P.O. Box 550
Richland, Washington 99352

Executive Summary

This document presents a revision (Rev. 1) to the 2010 (Rev. 0) groundwater monitoring plan[1] for the 216-A-29 Ditch. This revised monitoring plan is based on the requirements for interim status facilities, as defined by the *Resource Conservation and Recovery Act of 1976*[2] (RCRA) and the implementing requirements in WAC 173-303-400[3] which, in turn, specifies groundwater monitoring regulations under 40 CFR 265.[4] The U.S. Department of Energy (DOE), Richland Operations Office (RL) has undertaken revision of this RCRA groundwater monitoring plan, due to the age of the plan, and to ensure that the plan contains the most current Hanford groundwater monitoring information for the treatment, storage, and disposal (TSD) unit. This indicator evaluation program groundwater monitoring plan is the principal controlling document for conducting groundwater monitoring at the 216-A-29 Ditch.

The 216-A-29 Ditch is a nonoperating interim status TSD unit in the 200-EA-1 Operable Unit (OU), which is located above the underlying 200-PO-1 Groundwater OU. The 216-A-29 Ditch is located on the east end of the 200 East Area of the Hanford Site. The 216-A-29 Ditch was an unlined trench that passed beneath the east-central portion of the 200 East Area security fence. From 1970 until it was decommissioned in 1991, it ran northeast to the 216-B-3-series ditches, which discharged to the 216-B-3 Pond. For a portion of its 1,098 m (3,602 ft) length, the ditch ran down a natural gully. The 216-A-29 Ditch received corrosive dangerous waste (acidic [sulfuric acid] and caustic [sodium hydroxide]) liquid effluent and intermittent potentially hazardous chemical discharges from the Plutonium-Uranium Extraction (PUREX) Plant chemical sewer beginning in 1955. All discharges ceased in 1991, and the TSD unit underwent interim stabilization measures in 1991.

[1] DOE/RL-2008-58, 2010, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084331.

[2] *Resource Conservation and Recovery Act of 1976,* 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

[3] WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-400.

[4] 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol25/xml/CFR-2010-title40-vol25-part265.xml.

As the 216-A-29 Ditch received wastewater contaminated with dangerous waste or dangerous waste constituents, a groundwater monitoring program in accordance with 40 CFR 265 was implemented in 1988.[5,6] In 1990, statistical evaluation of specific conductance showed that concentrations in a single downgradient well (299-E25-35) were statistically greater than background levels. Resampling verified the specific conductance measurement. A required groundwater quality assessment plan[7] for the 216-A-29 Ditch was prepared and initiated. In 1995, results of the groundwater quality assessment program concluded that increased concentrations of sulfate, sodium, and calcium were the cause of the elevated specific conductance.[8] Because these constituents are not regulated as dangerous wastes, the site was returned to an indicator evaluation program in 1995.[9] Since the assessment, specific conductance has exceeded the critical mean in four wells historically used for downgradient monitoring (299-E25-35, 299-E25-48, 299-E25-32P, and 299-E26-13). Upgradient and downgradient wells show a correlation between both nitrate and sulfate concentrations and specific conductance values measured in the 216-A-29 Ditch well network. Elevated concentrations of sulfate and nitrate from upgradient source(s) are encroaching from the northwest and affecting the 216-A-29 Ditch. Concentrations of sulfate, nitrate, and chloride have increased in wells but did not exceed drinking water standards in 2014 (DOE/RL-2015-07[10]). Thus, releases of dangerous wastes subject to WAC 173-303-040[11] from the 216-A-29 Ditch

[5] DOE, 1987, *40 CFR 265 Interim Status Detection-Level Ground-Water Monitoring Compliance Plan for 216-A-29 Ditch*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0080806H.

[6] Luttrell, 1988, *Effluent Monitoring Plan for 216-A-29 Ditch Monitoring Wells*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0080803H.

[7] WHC-SD-EN-AP-031, 1990, *Interim-Status Groundwater Quality Assessment Plan for the 216-A-29 Ditch*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=E0009393.

[8] WHC-SD-EN-EV-032, 1995, *Results of Groundwater Quality Assessment Program at the 216-A-29 Ditch RCRA Facility*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=E0042415.

[9] WHC-SD-EN-EV-032, 1995, *Results of Groundwater Quality Assessment Program at the 216-A-29 Ditch RCRA Facility*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=E0042415.

[10] DOE/RL-2015-07, 2015, *Hanford Site Groundwater Monitoring Report for 2014*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0080600H.

[11] WAC 173-303-040, "Dangerous Waste Regulations," "Definitions," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-040.

are not considered to have contaminated the underlying groundwater. Therefore, the site remains under the indicator evaluation program described in 40 CFR 265.92.[12]

This RCRA groundwater monitoring plan presents a revised indicator evaluation program for detection monitoring of the uppermost aquifer beneath the 216-A-29 Ditch. This plan addresses the following:

- Number, locations, and depths of wells in the 216-A-29 Ditch groundwater monitoring network
- Sampling and analytical methods of parameters required for groundwater contamination detection monitoring
- Methods for evaluating groundwater quality information
- Schedule for groundwater monitoring at the 216-A-29 Ditch

This plan revises the existing groundwater monitoring well network identified in the previous groundwater monitoring plan (DOE/RL-2008-58, Rev. 0[13]) in order to accommodate changes in groundwater flow direction, avoid duplication of well sampling locations, and represent upgradient conditions more adequately. Two new downgradient wells will be installed to improve downgradient monitoring coverage for the central and northern portions of the 216-A-29 Ditch. Flow direction determinations indicate that groundwater flow varies from south to southeast along the length of the 216-A-29 Ditch. Groundwater in the 216-A-29 Ditch monitoring wells will be sampled and analyzed semiannually for the parameters used as indicators of groundwater contamination (pH, specific conductance, total organic carbon, and total organic halogen) and annually for parameters establishing groundwater quality (chloride, iron, manganese, phenols, sodium, and sulfate) in accordance with 40 CFR 265.92(b)(2)&(3) and (d). Site-specific constituents for analysis of general water chemistry including alkalinity, anions (nitrate), metals (calcium, magnesium, and potassium), and field parameters (temperature and

[12] 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol25/xml/CFR-2010-title40-vol25-sec265-92.xml.

[13] DOE/RL-2008-58, 2010, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084331.

turbidity) will be collected annually. Water level measurements will be taken each time a sample is collected to satisfy 40 CFR 265.92(e).

Contents

Appendices

Figures

Tables

Terms

AEA	Atomic Energy Act of 1954
bgs	below ground surface
CCU	Cold Creek unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CSL	chemical sewer line
CSM	conceptual site model
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FWS	Field Work Supervisor
HSU	hydrostratigraphic unit
OU	operable unit
QAPjP	quality assurance project plan
PUREX	Plutonium-Uranium Extraction
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	Richland Operations Office
TEDF	Treated Effluent Disposal Facility
TOC	total organic carbon
TOX	total organic halogen
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

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1 Introduction

This document presents the revised (Rev. 1) groundwater monitoring plan for the 216-A-29 Ditch and supersedes the previous plan (DOE/RL-2008-58, Rev. 0, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*). This groundwater monitoring plan is based on the requirements for interim status facilities, as defined by the *Resource Conservation and Recovery Act of 1976* (RCRA), with regulations promulgated by the Washington State Department of Ecology (Ecology) in the *Washington Administrative Code* (WAC), and the *Code of Federal Regulations* (CFR) by reference (WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards;" 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, "Ground-Water Monitoring"). This plan monitors indicator parameters in groundwater samples that are used to determine whether dangerous waste or dangerous waste constituents have entered the groundwater. This plan also monitors parameters used in establishing groundwater quality.

The 216-A-29 Ditch is a nonoperating, interim status treatment, storage, and disposal (TSD) unit regulated as a surface impoundment, as defined in WAC 173-303-040, "Definitions." From 1955 to 1986, this TSD unit received daily discharges of sodium hydroxide and sulfuric acid solutions from demineralizer operations at the 202-A Plutonium-Uranium Extraction (PUREX) Plant. The site also intermittently received off-specification process chemicals and chemical spills. For regulatory purposes, the TSD unit boundary of the 216-A-29 Ditch is identified on the current Hanford Facility Dangerous Waste Permit (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*) Part A Form.

The U.S. Department of Energy (DOE) submitted an updated RCRA closure plan for the 216-A-29 Ditch to Ecology in June 2014 (DOE/RL-2008-53, *216-A-29 Ditch Closure Plan (D-2-3)*). Closure of the 216-A-29 Ditch will be coordinated with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) as part of the 200-EA-1 Operable Unit (OU). It is anticipated that the site will be clean-closed, and post-closure groundwater monitoring will be addressed under the 200-PO-1 Groundwater OU.

The 216-A-29 Ditch is located in the eastern portion of the 200 East Area in the 200-EA-1 OU (Figure 1-1). The 216-A-29 Ditch was an excavation that, in part, follows a natural gully or small ravine, and was used for disposal of various waste streams from the PUREX Plant. Operating records indicate that the 216-A-29 Ditch began receiving wastewater from PUREX in 1955. All discharges ceased in 1991, and the 216-A-29 Ditch underwent interim stabilization measures during that same year (WHC-SD-DD-TI-060, *216-A-29 Ditch Interim Stabilization Final Report*).

The purpose of this RCRA plan is to present an updated groundwater monitoring program for parameters used as indicators of groundwater contamination from the 216-A-29 Ditch, commonly referred to as an indicator evaluation program. The plan is updated to accommodate a changing groundwater flow direction, avoid duplication of adjacent wells, and sample representative upgradient and downgradient groundwater conditions more effectively. This plan is intended specifically to satisfy monitoring requirements for interim status TSD units, as required by WAC 173-303-400(3) and 40 CFR 265.92. This monitoring plan is the principal controlling document for conducting groundwater monitoring at the 216-A-29 Ditch. The indicator evaluation program detailed in this plan requires semiannual sampling for parameters used as indicators of groundwater contamination, as well as annual sampling for parameters establishing groundwater quality for the three upgradient wells and three existing and two new downgradient wells. Site-specific constituents are identified for the 216-A-29 Ditch and will be sampled and analyzed annually. For the first year of sampling at the new wells, the sampling frequency for indicators of groundwater contamination, parameters establishing groundwater quality, and site-specific constituents will be quarterly. Water level measurements are also required each time a sample is collected to satisfy 40 CFR 265.92(e).

This groundwater monitoring plan addresses the operational history, current hydrogeology, and conceptual site model (CSM) for the site and incorporates knowledge about the potential for contamination originating from the 216-A-29 Ditch. Chapter 2 of this plan summarizes background information and references other documents that contain more detailed or additional information. Chapter 2 also describes the 216-A-29 Ditch and the regulatory basis, types of waste present, pertinent geology, and hydrogeology beneath the 216-A-29 Ditch and provides a brief history of groundwater monitoring. All of this information is summarized as a CSM to aid in development of the groundwater monitoring program. Chapter 3 describes the RCRA groundwater monitoring program, including the wells in the monitoring network, constituents analyzed, sampling frequency, and sampling protocols. Chapter 4 describes data evaluation and reporting; Chapter 5 provides an updated outline for a groundwater quality assessment plan, and Chapter 6 contains the references cited in this plan. Appendix A provides the quality assurance project plan (QAPjP), Appendix B contains sampling protocols, and Appendix C provides information for wells within the groundwater monitoring network.

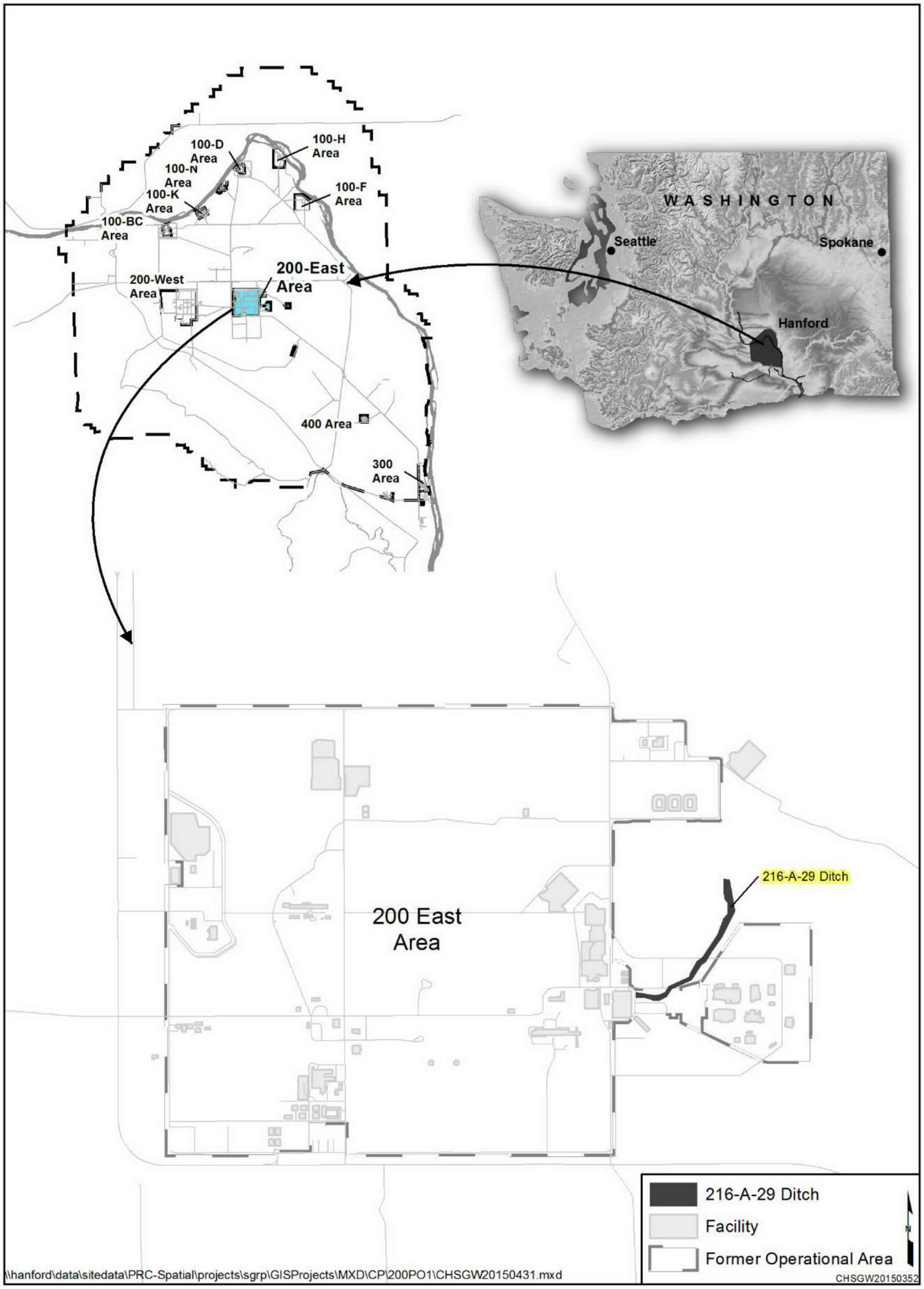

Figure 1-1. Location Map for the 216-A-29 Ditch

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2 Background

This chapter describes the 216-A-29 Ditch and its operating history, regulatory basis, wastes and waste characteristics associated with the 216-A-29 Ditch, local subsurface geology and hydrogeology, a summary of previous groundwater monitoring, and the CSM for the 216-A-29 Ditch. Site-specific constituents are also provided in this chapter.

The information contained in this chapter was obtained from several sources, including the Waste Information Data System general summary reports, previous groundwater monitoring plans listed in Table 2-2, and the following documents:

- DOE/RL-93-09, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1992*
- DOE/RL-2005-63, *Feasibility Study for the 200-CS-1 Chemical Sewer Group Operable Unit*
- DOE/RL-2008-01, *Hanford Site Groundwater Monitoring for Fiscal Year 2007*
- DOE/RL-2008-53, *216-A-29 Ditch Closure Plan (D-2-3)*
- DOE/RL-2009-85, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit*
- DOE/RL-2011-01, *Hanford Site Groundwater Monitoring Report for 2010*
- DOE/RL-2011-118, *Hanford Site Groundwater Monitoring for 2011*
- DOE/RL-2013-22, *Hanford Site Groundwater Monitoring Report for 2012*
- DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*
- DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014*
- PNL-10285, *Estimated Recharge Rates at the Hanford Site*
- WHC-SD-EN-EV-032, *Results of Groundwater Quality Assessment Program at the 216-A-29 Ditch RCRA Facility*

2.1 Facility Description and Operational History

The 216-A-29 Ditch was part of a liquid effluent conveyance system from the PUREX Plant chemical sewer line (CSL) to the 216-B-3-1, 216-3-2, or 216-3-3 Ditches. It was put into service in November 1955. The 216-A-29 Ditch initially discharged to the 216-B-3-1 Ditch (Figure 2-1); however, when the 216-B-3-1 Ditch was retired in 1964, the 216-A-29 Ditch was shortened and then discharged to the 216-B-3-2 Ditch. The 216-B-3-2 Ditch was retired in 1970. As a result, the 216-A-29 Ditch was again rerouted and discharged to the 216-B-3-3 Ditch until 1991. The 216-A-29 Ditch was interim stabilized in 1991. Discharges from the PUREX CSL were rerouted to the PUREX cooling water line and then to the 216-B-3-3 Ditch (DOE/RL-93-09; WHC-SD-DD-TI-060).

The 216-A-29 Ditch was approximately 1.8 m (6 ft) to 24 m (80 ft) wide and 1,097 m (3,600 ft) long, and it varied from 0.6 to 0.9 m (2 to 3 ft) deep at the south end to nearly 5 m (16 ft) deep at the north end. The CSL discharged into the head end of the ditch, at a point approximately 274 m (900 ft) west of the east perimeter fence line of the 200 East Area. The ditch passed beneath the 200 East Area perimeter fence and ran northeast to the 216-B-3 Ditches, which discharged to the 216-B-3 Ponds. For the first 213 m (700 ft), the ditch was relatively level and shallow. The lower 884 m (2,900 ft) was confined within a steep-sided canyon averaging 24 m (80 ft) wide and dropping nearly 30 m (100 ft) in elevation (WHC-SD-EN-AP-031, *Interim-Status Groundwater Quality Assessment Plan for the 216-A-29 Ditch*).

Flow from the CSL was continuous until the end of its operation in 1991, with the volume discharged ranging from 950 to 4,164 L/min (250 to 1,100 gal/min) and an average flow of approximately 3,671 L/min (1,000 gal/min). An unknown amount of effluent discharged to the ditch infiltrated the soil while flowing along the course of the ditch.

The 216-A-29 Ditch is currently backfilled with material from the ditch sides and spoils piles in the bottom. The portion of the 216-A-29 Ditch inside the 200 East Area security fence was brought up to grade with clean material. The portion of 216-A-29 Ditch outside of the 200 East Area security fence was topped with clean material in a series of 11 terraces progressing down the length of the ditch. Both areas have been revegetated with appropriate signage posted (the 216-A-29 Ditch is an underground radioactive material area).

2.2 Regulatory Basis

In May 1987, DOE issued a final rule (10 CFR 962, "Byproduct Material"), stating that the hazardous waste components of mixed waste are subject to RCRA regulations. In November 1987, the U.S. Environmental Protection Agency (EPA) authorized Ecology to regulate these hazardous waste components within the State of Washington (51 FR 24504, "EPA Clarification of Regulatory Authority Over Radioactive Mixed Waste"). In 1996, the Washington State Attorney General determined that the effective date for regulation of mixed waste in Washington State was August 19, 1987.

In May 1989, DOE, EPA, and Ecology signed the Tri-Party Agreement (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*). This agreement established the roles and responsibilities of the agencies involved in regulating and controlling remedial restoration of the Hanford Site, which includes the 216-A-29 Ditch. Groundwater monitoring is conducted at the 216-A-29 Ditch in accordance with WAC 173-303-400(3) (and by reference, 40 CFR 265, Subpart F), which requires monitoring to determine whether dangerous waste constituents from the waste site have entered the groundwater.

Dangerous waste is regulated under RCRA, as modified in 40 CFR 265 and RCW 70.105, "Hazardous Waste Management," and its implementing requirements in the Washington State dangerous waste regulations (WAC 173-303-400). Radionuclides in mixed waste may include source, special nuclear, and byproduct materials, as defined in the *Atomic Energy Act of 1954* (AEA). Both RCRA and AEA state that these radionuclide materials are regulated at DOE facilities, exclusively by DOE, acting pursuant to its AEA authority. Radionuclide materials are not hazardous/dangerous wastes and, therefore, are not subject to regulation by the State of Washington under RCRA or RCW 70.105.

Groundwater monitoring at 216-A-29 Ditch was initiated in 1988 under DOE, 1987, *40 CFR 265 Interim Status Detection-Level Ground-Water Monitoring Compliance Plan for 216-A-29 Ditch*, as supplemented by Luttrell, 1988, *Effluent Monitoring Plan for 216-A-29 Ditch Monitoring Wells*, based on the interim status indicator evaluation program requirements of 40 CFR 265, Subpart F and WAC 173-303-400.

The 216-A-29 Ditch received a continuous discharge of corrosive waste and potentially hazardous spilled chemical materials from the PUREX Plant. The most significant chemical discharges included acidic and caustic effluents (sodium hydroxide and sulfuric acid solutions) associated with backwashing for the regeneration of demineralizer columns. The ditch also received spills from the PUREX Plant CSL.

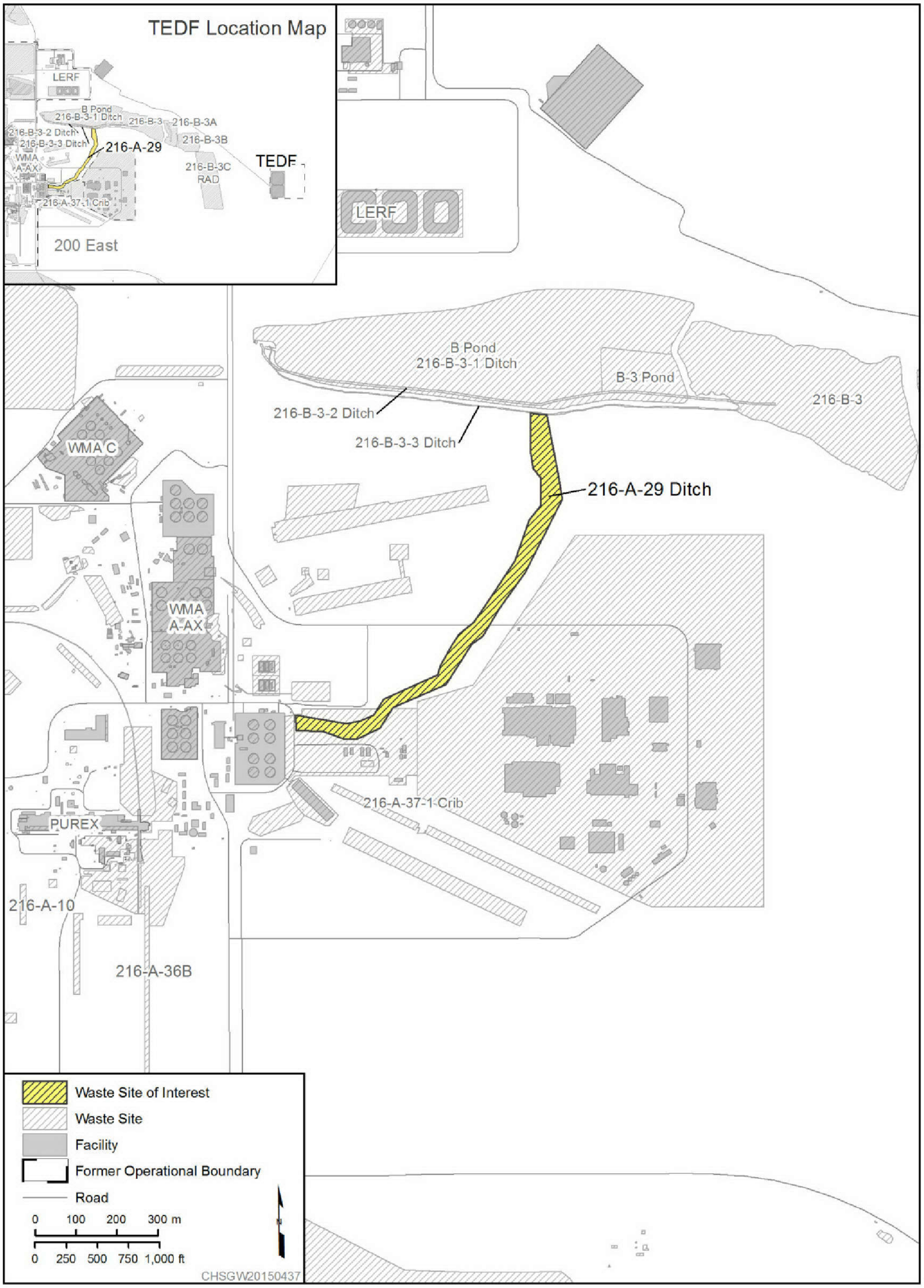


Figure 2-1. Site Map of the 216-A-29 Ditch and Surrounding Facilities

Interim status indicator parameter monitoring was performed from 1988 to 1990, when monitoring was changed to a groundwater quality assessment program (40 CFR 265.93[d]) because of elevated levels of specific conductance in a downgradient well (299-E25-35). Elevated total organic halogens (TOX) were also listed as a constituent of concern in WHC-SD-EN-AP-031. DOE issued WHC-SD-EN-EV-032 in 1995, which identified sodium, sulfate, and calcium as causes of elevated specific conductance. Because these constituents are not regulated as dangerous wastes, the report concluded that the groundwater had not been adversely impacted. Furthermore, no known or suspected cause of the elevated concentrations was identified. As a result of these findings, the 216-A-29 Ditch reverted to indicator parameter monitoring in 1995 under the supplemental groundwater monitoring plan in the appendix to the assessment report (WHC-SD-EN-EV-032). This supplement was subsequently revised in 1999 as PNNL-13047, *Groundwater Monitoring Plan for the 216-A-29 Ditch*. Since the assessment, concentrations of TOX have subsequently dropped below the critical mean for the site. An indicator evaluation program that monitors parameters required for groundwater contamination detection continues to this day under a monitoring plan published in 2010 (DOE/RL-2008-58, Rev. 0). More recently, elevated levels of specific conductance were also attributed to widely distributed plumes of nitrate and sulfate in the area (DOE/RL-2008-01).

2.3 Waste Characteristics

The 216-A-29 Ditch received corrosive dangerous waste from the PUREX Plant. The discharges consisted of acidic (sulfuric acid) and caustic (sodium hydroxide) backwashes from the regeneration of demineralizer columns in the PUREX Plant. From 1955 to 1986, discharges of sodium hydroxide and sulfuric acid solutions occurred on a daily basis. Treatment of this waste occurred by the successive addition of acidic and caustic waste, which served to neutralize waste in the ditch. The ditch also received spills from the PUREX Plant. Waste from the PUREX CSL was discharged to the 216-A-29 Ditch until 1991 when the ditch was stabilized. Analysis of the waste discharged after 1986 indicated the waste was non-dangerous (DOE, 1987; WHC-SD-EN-AP-045, *Groundwater Monitoring Plan for the 216-A-29 Ditch*). Table 2-1 provides a summary of hazardous discharges to the crib. The dangerous waste consists of corrosive, toxicity characteristic waste, acutely dangerous discarded chemical products, and state-only waste (WA7890008967).

Table 2-1. Known Hazardous Discharges to the 216-A-29 Ditch

Waste Constituent	Date	Description
Demineralizer regenerant	1955 to February 1986	Characteristic (corrosive)
Aqueous makeup tank heels and off-specification batches	1955 to October 1984	Characteristic (corrosive and toxic)
N-Cell prestart testing (oxalic acid, nitric acid, hydrogen peroxide, calcium nitrate)	April 11, 1983 to August 7, 1983	Characteristic (corrosive)
Potassium permanganate, sodium carbonate solution	October 19, 1983	CERCLA reportable release
Hydrazine solution	June 6, 1984 September 13, 1984 to October 2, 1984	CERCLA reportable release
Potassium hydroxide	December 2, 1984	CERCLA reportable release

Table 2-1. Known Hazardous Discharges to the 216-A-29 Ditch

Waste Constituent	Date	Description
Nitric acid	August 22, 1984 January 18, 1985 May 27, 1985 June 25, 1985 October 28, 1985	CERCLA reportable release
Sodium hydroxide	February 26, 1984 November 19, 1984 August 6, 1985	CERCLA reportable release
Cadmium nitrate	May 16, 1984 December 18, 1985	CERCLA reportable release
Hydrazine	July 9, 1986	CERCLA reportable release

Note: Table is adapted from DOE, 1987, *40 CFR 265 Interim Status Detection-Level Ground-Water Monitoring Compliance Plan for 216-A-29 Ditch*.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

2.4 Geology and Hydrogeology

Information concerning the geology and hydrogeology of the 200 East Area, including the region of the 216-A-29 Ditch, is provided in the following documents:

- CP-57037, *Model Package Report: Plateau to River Groundwater Transport Model Version 7.1*
- DOE/RL-2009-85, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit*
- DOE/RL-2011-01, *Hanford Site Groundwater Monitoring Report for 2010* (Chapter 2, "Overview of Hanford Hydrogeology and Geochemistry")
- DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*
- DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014*
- ECF-Hanford-13-0029, *Development of the Hanford South Geologic Framework Model, Hanford Site Washington*
- PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*
- SGW-54165, *Evaluation of the Unconfined Aquifer Hydraulic Gradient Beneath the 200 East Area, Hanford Site*
- WHC-SD-EN-TI-012, *Geologic Setting of the 200 East Area: An Update*

2.4.1 Stratigraphy

Figure 2-2 summarizes the general stratigraphy at the Hanford Site. The following stratigraphic units underlying the 200 East Area within the vicinity of the 216-A-29 Ditch are listed in order from upper to lower (DOE/RL-2009-85):

- A discontinuous veneer of Holocene eolian silty sand or backfill mixtures of sand and gravel.
- Hanford formation (Pleistocene Age) – Cataclysmic flood deposits equivalent to hydrostratigraphic unit (HSU) 1. The Hanford formation consists of three facies subunits (silt dominated, sand dominated, and gravel dominated), which grade into one another both vertically and laterally (Figure 2-2). On the central plateau, the Hanford formation is sometimes further delineated into H1, H2, and H3 lithostratigraphic sequences. The H1 and H3 gravel sequences are not differentiated in those areas where the intervening sandy H2 sequence is absent. Units H1 and H3 consist of coarse-grained, basalt-rich, sandy gravels with varying amounts of silt/clay. The H2 sequence is dominated by sand to gravelly sand, with minor sandy gravel or silt/clay interbeds.
- Cold Creek unit (CCU) (Pliocene Age) – equivalent to HSUs 2 and 3. The CCU is often undifferentiated but has been subdivided regionally into three subunits, which include the Cold Creek units Z (Early Palouse Soil) and C (caliche), both of which are primarily located in 200 West Area, and unit G (pre-Missoula gravels), which is primarily located beneath 200 East Area and vicinity. In much of the 200 East Area (including beneath the 216-A-29 Ditch), the CCU is characterized as a quartzo-feldspathic sandy gravel (unit G) above the Ringold Formation and below the more basaltic gravels and sands of the Hanford formation.
- Ringold Formation Unit A (Miocene Age) – equivalent to HSU 9. Unit 9 can be further subdivided into three HSUs based on markedly different lithologies and hydraulic properties. The primary subunit is characterized as a silt to clay-rich confining zone with lower permeability, classified as unit 9B. Subunits 9A and 9C have much higher permeabilities and lower clay content and consist of consolidated silty sandy gravel deposits.
- Bedrock consisting of Columbia River Basalt flows dip gently to the south toward the axis of the Cold Creek syncline. The two uppermost flows are within the Elephant Mountain Member of the Saddle Mountains Basalt.

HSUs 4 through 8 are not present beneath the 216-A-29 Ditch. Geologic cross sections, which include selected wells in the southern portion of the 200 East Area, present the approximate stratigraphy underlying and adjacent to the 216-A-29 Ditch (Figures 2-3 and 2-4).

2.4.2 Hydrogeology

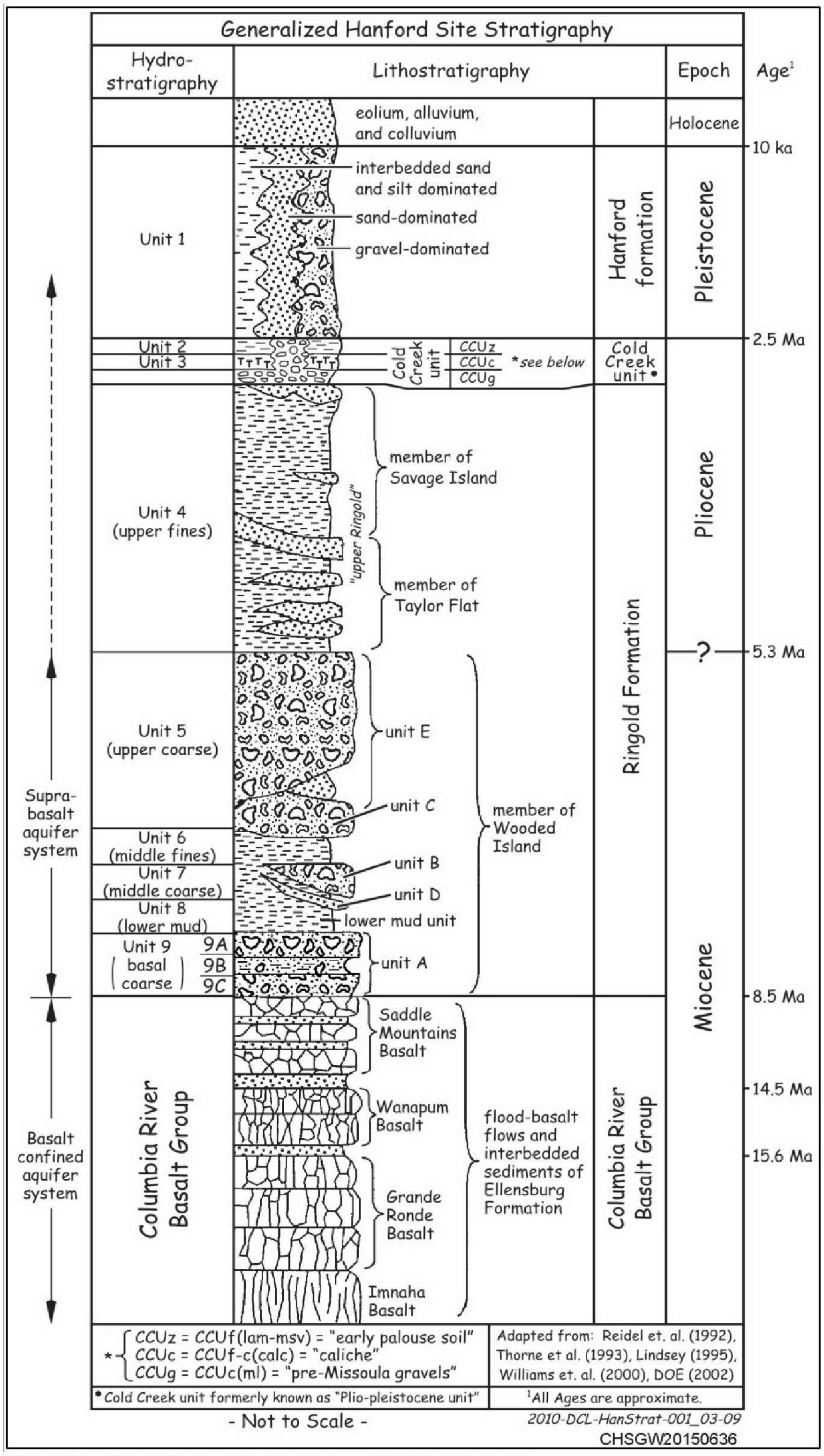
The water table beneath the 216-A-29 Ditch is at a depth of approximately 85 m (279 ft) below ground surface (bgs) at the southwest end of the ditch and 60 m (197 ft) bgs at the northeast end of the ditch, within the lower part of the Hanford formation or the upper part of the CCU (Figures 2-3 and 2-4). The unconfined aquifer is primarily within the CCU and Ringold Formation Unit A. It ranges from 27 m (89 ft) thick at the southwest end of the trench, where the CCU and Ringold Formation Unit A are thickest, to 10 m (33 ft) thick at the northeast end of the trench where the CCU and Ringold Formation Unit A are thinner.

The CCU and Hanford formation have higher hydraulic conductivity than the underlying Ringold Formation Unit A. Based on recent groundwater flow and transport modeling iterations, the average hydraulic conductivity for the Hanford formation and CCU where channelized flow occurs (paleochanneling containing the more permeable Hanford formation) is estimated to be approximately 17,000 m/day (55,800 ft/day). Hydraulic conductivity is lower, 2.3 to 109.0 m/day (7.5 to 357.6 ft/day), in those areas without channelized flow where Ringold Formation Unit A sediments predominate (CP-57037). Due to high hydraulic conductivity, the water table in the area where the ditch is located is very flat with an extremely low hydraulic gradient.

2.4.3 Groundwater Flow Interpretation

Currently, the unconfined aquifer in the 200 East Area has a very low hydraulic gradient, making it difficult to determine groundwater flow direction. The hydraulic gradient of the water table in the area around the 216-A-29 Ditch is calculated to be 2.0×10^{-5} m/m (DOE/RL-2015-07) (Figure 2-5). Estimated flow directions in different portions of the 200 East Area have been determined through statistical analysis of water levels obtained from wells comprising the low-gradient monitoring well network in conjunction with tracking contaminant plume movements (Figure 2-5). In 2013, the local groundwater flow direction near the 216-A-29 Ditch was interpreted to have an azimuth of approximately 166 degrees ±20 degrees, based on measurements from the low-gradient monitoring network (Figure 2-6). Water table elevations and local flow directions occasionally show temporary changes due to discharges from the 200 East Area Treated Effluent Disposal Facility (TEDF) (Figure 2-1) and possibly from elevated Columbia River water levels (SGW-54165).

Historically, water levels in the unconfined aquifer increased as much as 5.5 m (18 ft) above the pre-Hanford natural water table level near the 216-A-29 Ditch. This increase was the result of artificial recharge from liquid waste disposal operations (e.g., PUREX Cribs and B Pond) between the mid-1940s and 1997. While the 216-B-3 Pond was in operation, artificial recharge created a significant groundwater mound, resulting in a radial flow pattern around B Pond that impeded flow towards the east and redirecting it to the southwest. After discharges to B Pond ceased, the mound at B Pond subsided, and groundwater flow directions in the southeastern portion of the 200 East Area and vicinity of the 216-A-29 Ditch changed to the south and southeast (Figure 2-6).



Note: Complete reference citations are provided in Chapter 6.

Figure 2-2. General Stratigraphy at the Hanford Site

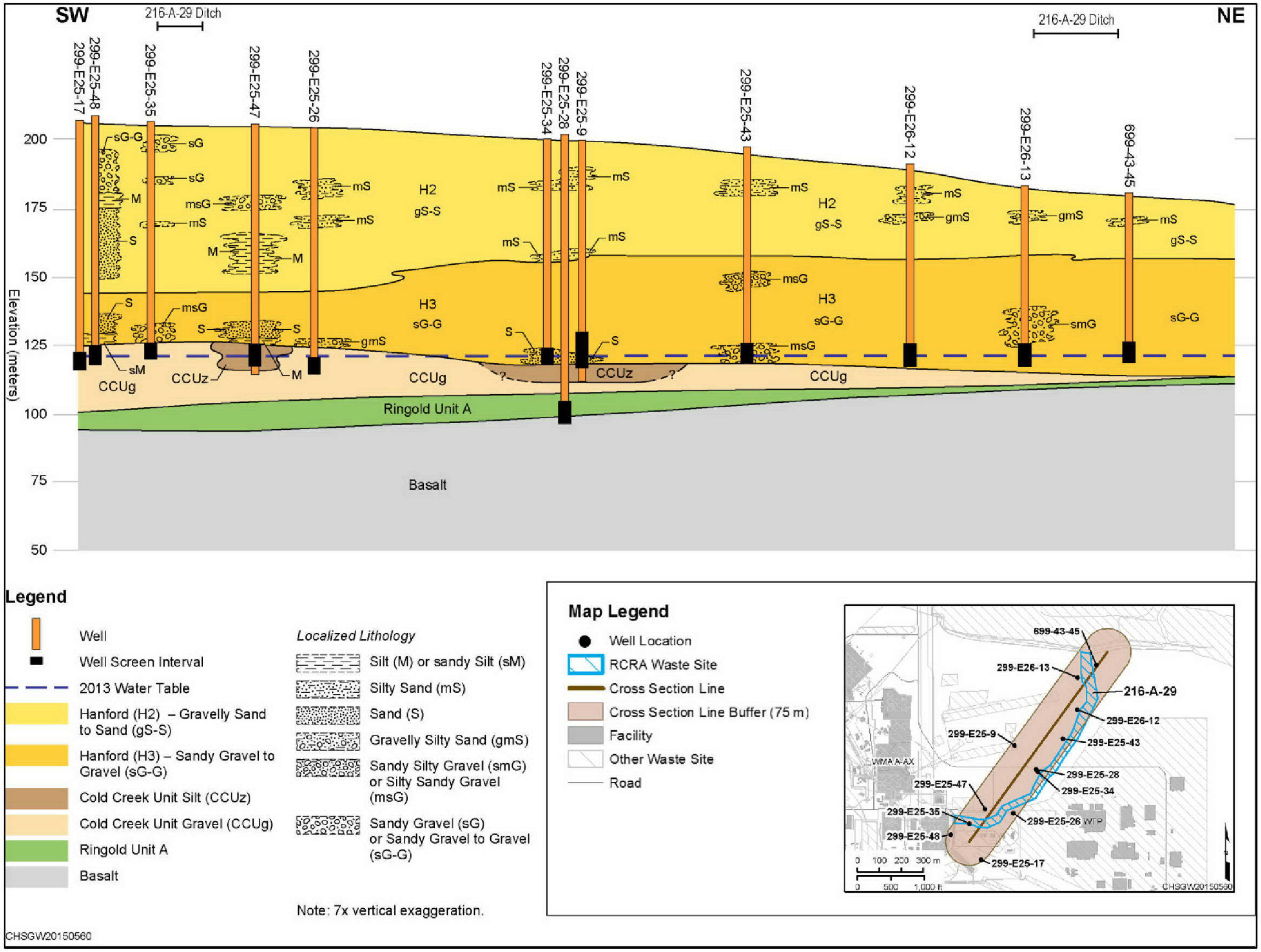


Figure 2-3. Southwest-Northeast Geologic Cross Section Showing the Stratigraphy Underlying the 216-A-29 Ditch

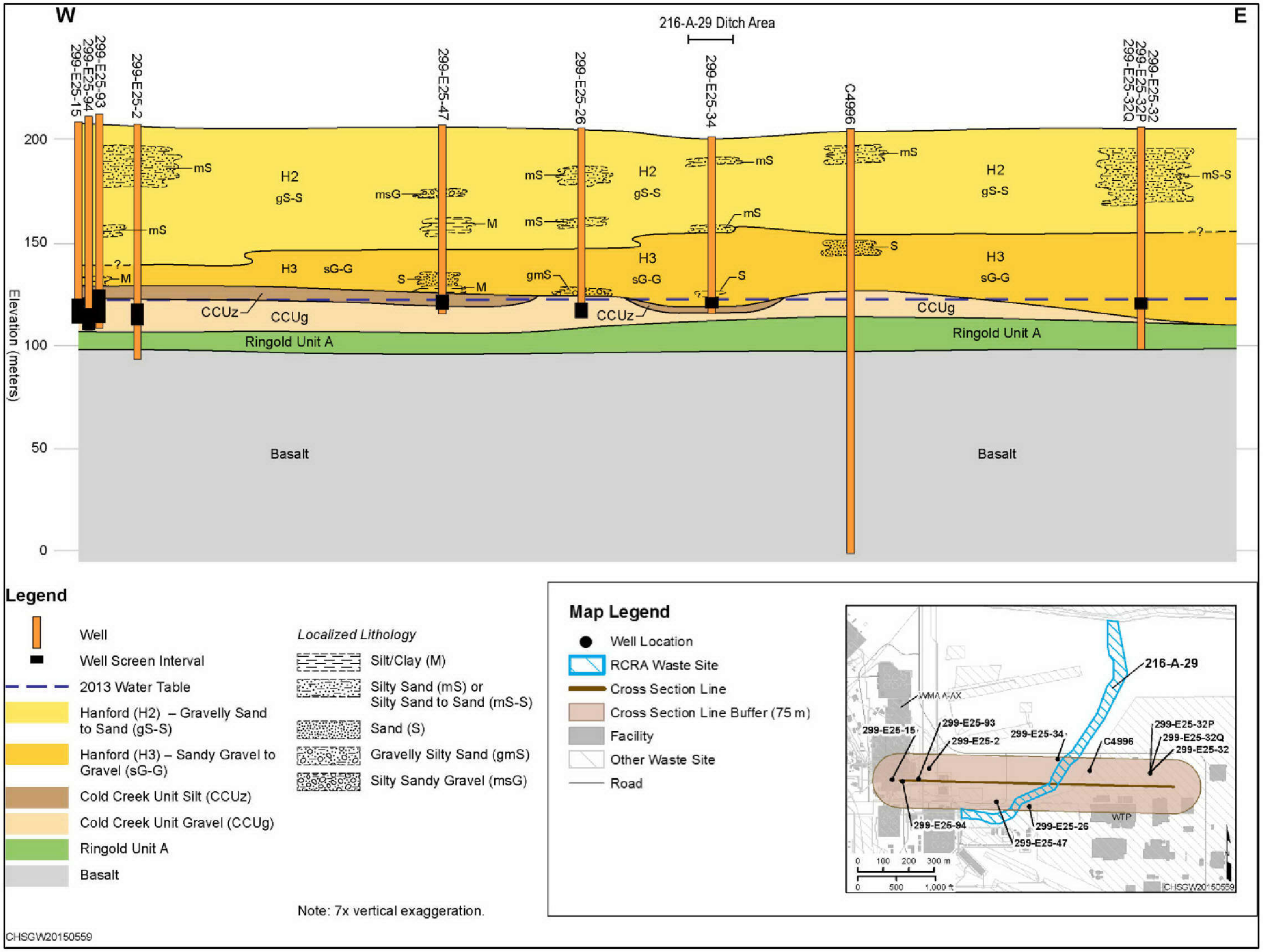
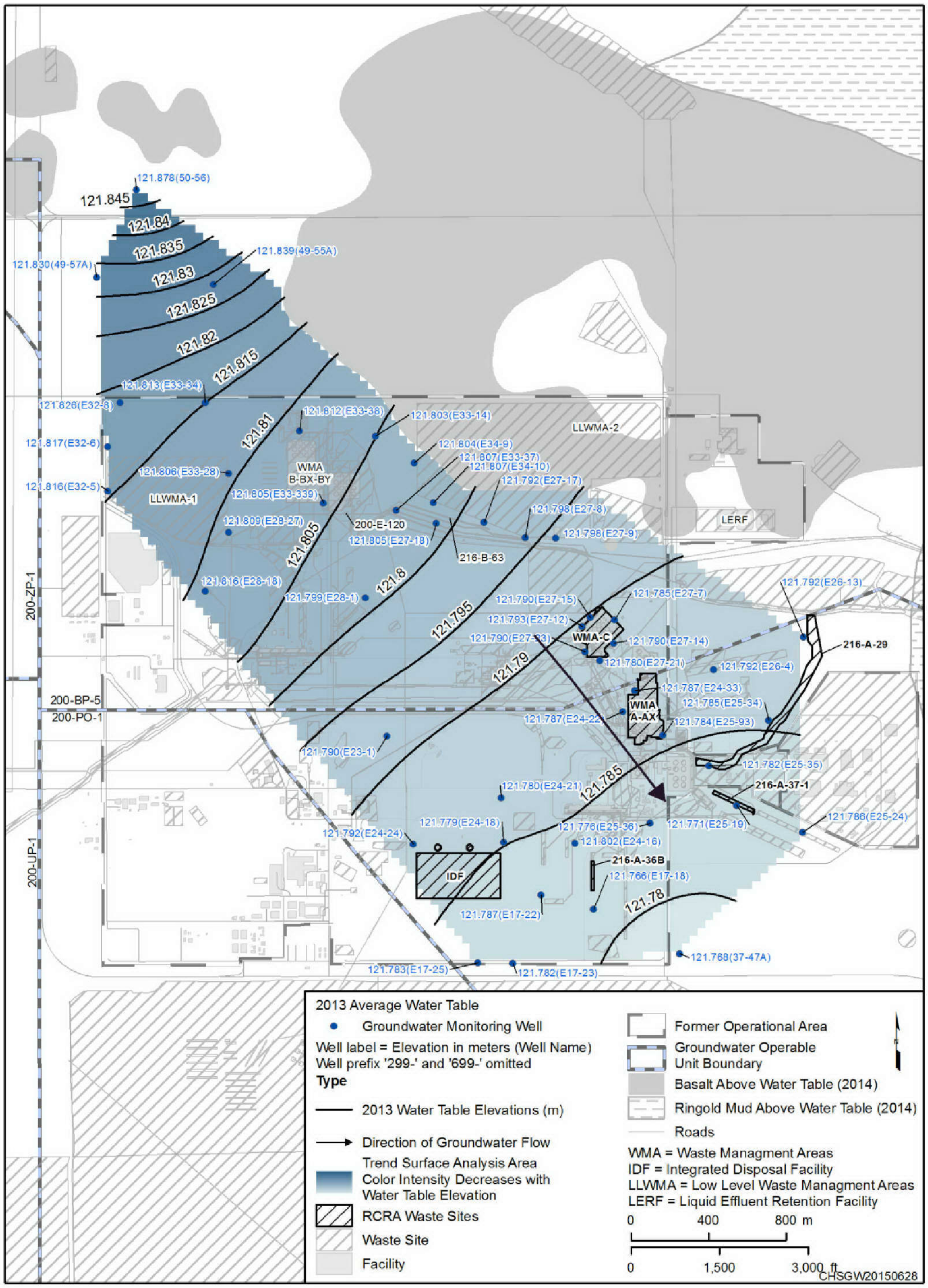


Figure 2-4. West-East Geologic Cross Section Showing the Stratigraphy Underlying the 216-A-29 Ditch



Reference: SGW-54165, *Evaluation of the Unconfined Aquifer Hydraulic Gradient Beneath the 200 East Area, Hanford Site*.

Note: Blue shading delineates area of low-gradient network modeling. The intensity of color decreases with decreasing elevation of water table.

Figure 2-5. Water Table Map for 200 East and the 216-A-29 Ditch Area

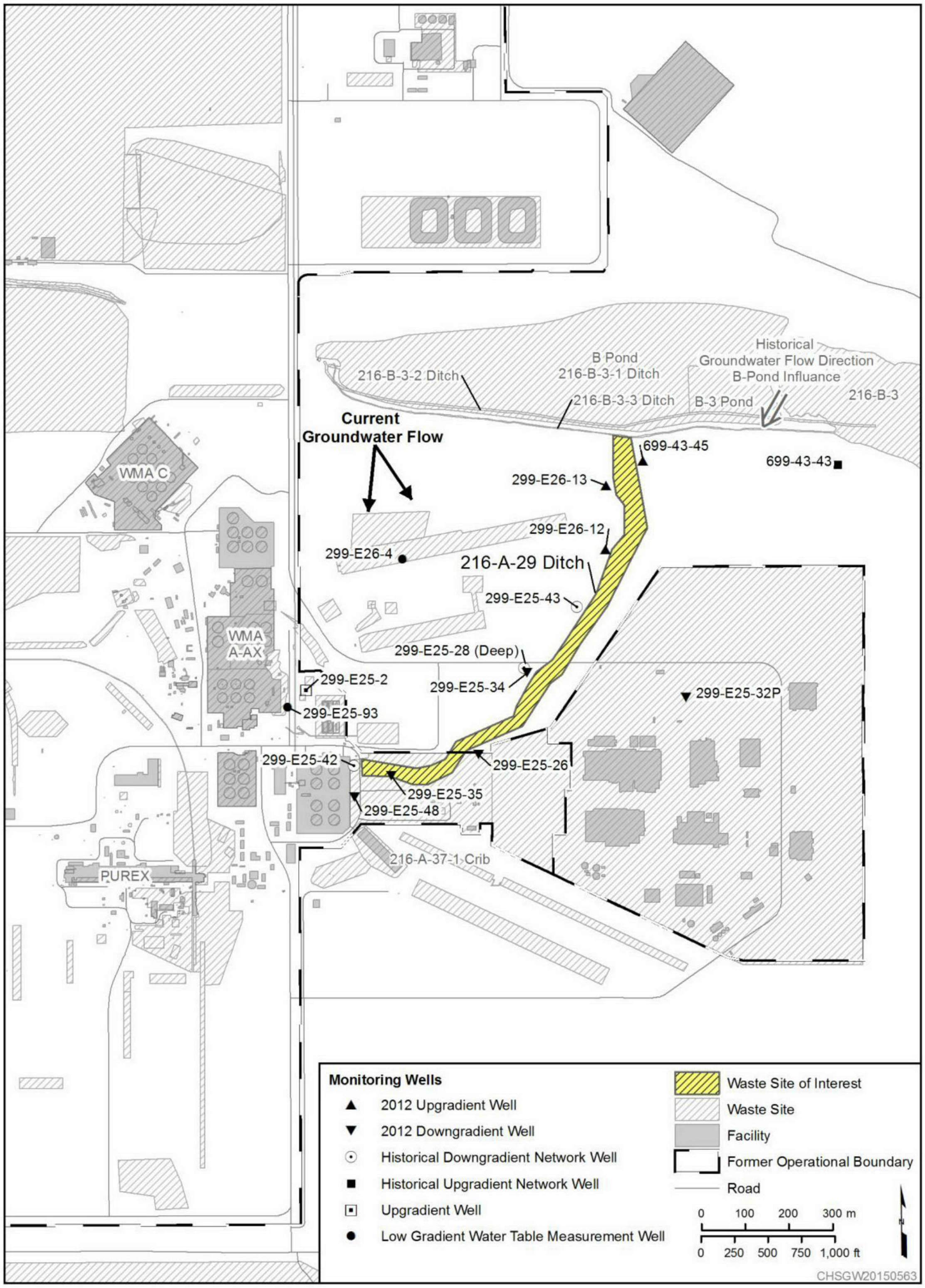


Figure 2-6. Estimated Local Flow Direction and Historical Monitoring Networks near the 216-A-29 Ditch

2.5 Summary of Previous Groundwater Monitoring

Table 2-2 lists the previous groundwater monitoring plans implemented at the 216-A-29 Ditch.

Table 2-2. Previous Monitoring Plans

Document	Date Issued	Monitoring Program[a]
40 CFR 265 Interim Status Detection-Level Ground-Water Monitoring Compliance Plan for 216-A-29 Ditch (DOE, 1987)	1987	Indicator Evaluation Program
Effluent Monitoring Plan for 216-A-29 Ditch Monitoring Wells (Luttrell, 1988)[b]	1988	Indicator Evaluation Program
Interim-Status Groundwater Quality Assessment Plan for the 216-A-29 Ditch (WHC-SD-EN-AP-031, Rev. 0)	1990	Groundwater Quality Assessment Program
Groundwater Monitoring Plan for the 216-A-29 Ditch (WHC-SD-EN-AP-045, Rev. 0 and Rev. 0A)	1991 and 1992	Groundwater Quality Assessment Program
Appendix C of *Results of Groundwater Quality Assessment Program at the 216-A-29 Ditch RCRA Facility* (WHC-SD-EN-EV-032, Rev. 0)	1995	Indicator Evaluation Program
Groundwater Monitoring Plan for the 216-A-29 Ditch (PNNL-13047)	1999	Indicator Evaluation Program
Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch (DOE/RL-2008-58, Rev. 0)	2010	Indicator Evaluation Program

a. The Indicator Evaluation Program satisfies the requirements of 40 CFR 265.92(b)(2), (b)(3), (d)(1), (d)(2), and (e), "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis." The groundwater quality assessment program's first determination satisfies the requirements of 40 CFR 265.93(d)(4) and (d)(6), "Preparation, Evaluation, and Response."

b. Luttrell, 1988 supplemented DOE, 1987 with direction on drilling activities for new wells.

RCRA groundwater monitoring was initiated at the 216-A-29 Ditch in 1988 under an indicator evaluation monitoring plan in accordance with DOE, 1987 as supplemented by Luttrell, 1988. The plan included sampling for contamination indicator parameters (pH, specific conductance, total organic carbon [TOC], and TOX), groundwater quality parameters (chloride, iron, manganese, phenols, sodium, and sulfate), and contamination indicator drinking water parameters (arsenic, barium, cadmium, chromium, fluoride, lead, mercury, nitrate, selenium, silver, endrin, lindane, methoxychlor, toxaphene, 2,4-D, 2,4,5-TP silvex, radium, gross alpha, gross beta, turbidity, and coliform). The monitoring plan included four new wells planned for 1988 and 1989. However, only three new wells (299-E25-26, 299-E25-34, and 299-E25-35) that monitored 216-A-29 were installed, all in 1988. The well network (as reported in WHC-SD-EN-AP-031) consisted of one upgradient well (299-E25-32P) and four downgradient wells (299-E25-26, 299-E25-28, 299-E25-34, and 299-E25-35) (Figure 2-6). These wells were sampled quarterly for one year to establish background levels. In late 1989, network groundwater monitoring was completed for four quarters, and background values were established.

Statistical evaluation of the first indicator evaluation monitoring results in January 1990 showed that the specific conductance value in downgradient well 299-E25-35 (Figure 2-6) was statistically greater than the background levels (WHC-SD-EN-AP-031). Resampling later verified this measurement, and the required groundwater quality assessment plan (WHC-SD-EN-AP-031) was prepared and implemented for the 216-A-29 Ditch in 1990. The plan included sampling for contamination indicator, groundwater quality, drinking water, site-specific (hydrazine and ammonium), and assessment monitoring (metals and anions) parameters. Thirteen wells (299-E17-15, 299-E17-20, 299-E25-11, 299-E25-15, 299-E25-18, 299-E25-19, 299-E25-20, 299-E25-21, 299-E25-26, 299-E25-28, 299-E25-32P, 299-E25-34, and 299-E25-35) were included. Analyses targeting halogenated compounds (herbicides, pesticides, enhanced volatiles, acid/base/neutrals, and polychlorinated biphenyls) were added to upgradient well 299-E25-32P due to previous results (WHC-SD-EN-AP-031).

Flow direction in the network changed over the monitoring period. By December 1990, it was apparent that the water level in the upgradient network well (299-E25-32P) had decreased and was no longer representative of upgradient conditions (WHC-SD-EN-AP-045, Rev. 0). Upgradient Well 299-E25-32P was replaced with two existing wells (699-43-43 and 699-43-45), and four new downgradient wells were installed (299-E25-42, 299-E25-43, 299-E26-12, and 299-E26-13). The following year, two additional downgradient wells were proposed (WHC-SD-EN-AP-045, Rev. 0A).

The final assessment report, issued in 1995 (WHC-SD-EN-EV-032), identified increased sulfate, sodium, and calcium as the causes of elevated specific conductance in well 299-E25-35. Because these constituents are not regulated as dangerous wastes, the report concluded that groundwater had not been adversely impacted, and the 216-A-29 Ditch reverted to an indicator evaluation monitoring program in 1995 under the supplemental groundwater monitoring plan provided in the assessment report (WHC-SD-EN-EV-032, Appendix C).

The 1995 indicator evaluation monitoring plan in Appendix C of WHC-SD-EN-EV-032 included two upgradient wells (699-43-43 and 699-43-45) and eight downgradient wells (299-E25-12, 299-E25-13, 299-E25-26, 299-E25-28, 299-E25-32P, 299-E25-34, 299-E25-35, and 299-E25-48). Semiannual samples were collected for contamination indicator parameters, alkalinity, and anions and annual samples were collected for inductively coupled plasma metals. Based on the groundwater quality assessment results, site-specific parameters (hydrazine and ammonium) were not included for further sampling. Phenols were not included because they were not discharged to the ditch and had never been detected in groundwater samples.

The monitoring plan was revised again in 1999 (PNNL-13047), using the same well network, with the removal of Well 299-E25-32P. The previous analyses were retained, and phenols and turbidity were added as site-specific constituents. All samples were collected annually, except for contamination indicator parameters, which were collected semiannually.

In 2010, a revised monitoring plan (DOE/RL-2008-58, Rev. 0) for the 216-A-29 Ditch, which utilized a network of nine wells, was approved. Wells 699-43-45 and 299-E26-13 were identified as upgradient, and Wells 299-E25-26, 299-E25-28, 299-E25-32P, 299-E25-34, 299-E25-35, 299-E25-48, and 299-E26-12 were designated as downgradient. In PNNL-13047 and DOE/RL-2008-58 (Rev. 0), Well 299-E25-28 was used for monitoring the bottom of the unconfined aquifer (Figure 2-6). Recognizing the shift in groundwater flow direction, Well 266-E26-12 was redefined as an upgradient well beginning in 2011 (DOE/RL-2011-118; DOE/RL-2013-22).

Specific conductance exceedances at the 216-A-29 Ditch have occurred during the monitoring history in Wells 299-E25-35, 299-E25-48, 299-E25-32P, and 299-E26-13 (Figure 2-6). The increased levels of specific conductance coincide with a general, multi-year increase in ionic strength throughout much of the 200 East Area and adjacent areas. The increase has not been attributed to the 216-A-29 Ditch (DOE/RL-2008-01). In 2014, specific conductance exceeded the critical mean in Wells 299-E25-35, 299-E25-48, and 299-E25-32P (DOE/RL-2015-07) (Figure 2-6). Concentrations of sulfate, nitrate, and chloride do not exceed drinking water standards (DOE/RL-2015-07). Mapping of sulfate concentrations in the 200 East Area in 2013, in conjunction with groundwater flow direction determinations, indicates that the more concentrated portion of a sulfate plume is encroaching from the northwest and significantly impacting sulfate and specific conductance levels at the southern end of the 216-A-29 Ditch (Figure 2-7). Trend plots of sulfate, nitrate, and specific conductance from upgradient and downgradient wells show the correlation between both nitrate and sulfate concentrations and specific conductance values measured in the 216-A-29 well network (Figure 2-8). A downgradient well (299-E25-35) has shown the greatest rate of increase and highest sulfate concentrations and specific conductance levels. Well 299-E25-2, located directly upgradient of Well 299-E25-35, is a good indicator of the higher sulfate and nitrate levels that are encroaching from the northwest and affecting the 216-A-29 Ditch from upgradient source(s).

Groundwater monitoring activities, under this monitoring plan at the 216-A-29 Ditch, sample from a network of three upgradient wells (299-E25-2, 299-E25-34, and 299-E26-13), three existing downgradient wells (299-E25-26, 299-E25-32P, and 299-E25-35), and two new downgradient wells. Samples are analyzed semiannually for parameters used as indicators of groundwater contamination and annually for parameters establishing groundwater quality. Water level measurements are collected each time a sample is obtained from a network well. The network wells are also included in the annual comprehensive March water level measurement campaign (SGW-38815, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*). Groundwater monitoring results are summarized each year for the 216-A-29 Ditch in the annual groundwater monitoring report.

2.6 Conceptual Site Model

This section describes the 216-A-29 Ditch CSM for potential contaminant transport to guide groundwater monitoring. The CSM is shown in Figure 2-9. The CSM describes the current understanding of the contaminant release and transport and includes the following site characteristics and assumptions:

- Historically, the 216-A-29 Ditch was an open and unlined trench that allowed discharged liquid effluents to evaporate and percolate into vadose sediments along its entire length. The highest infiltration occurred within the first few meters (southwest end) of the ditch.
- As a consequence of the historical high volume surface discharges, a portion of liquid wastes released in the ditch migrated through the vadose zone and into the groundwater.
- Mobile liquid constituents, such as nitrate or sulfate, that migrated through the vadose zone, intercepted and mixed with groundwater in the unconfined aquifer and then moved laterally with groundwater flow.
- Low-mobility constituents (e.g., cadmium) remain in the shallow sediments below the ditch. Vadose zone test pits excavated in 2002 for CERCLA site characterization showed that the low-mobility constituents tended to be sorbed near the inlet end of the ditch and in the upper 2.9 m (10 ft) of the soil column (DOE/RL-2005-63).
- Groundwater flow directions have reverted to the flow pattern that existed before the large discharges to B Pond. A south to southeast groundwater flow direction is currently indicated, based on nitrate and sulfate plume migration in the area and water table elevation measurements obtained from wells comprising the low-gradient water level measurement network (Figures 2-6 and 2-7). The water table in the 200 East Area has declined significantly since discharges to B Pond completely ceased in 1997. The rate of decline has decreased in the last 5 years, with an average decrease in the water table elevation of approximately 0.3 ft (0.1 m) between 2010 and 2015.

- A large region of channel deposits comprised of Hanford formation and CCU sediments extends across the southeastern portion of 200 East and includes the area of the 216-A-29 Ditch. Channel sediments fill an erosional scour that has removed a portion of the older Ringold Formation sediment (i.e., Unit E and the Ringold lower mud unit). Along most of the 216-A-29 Ditch, the CCU directly overlays sand and gravel of the Ringold Formation Unit A (Figures 2-3 and 2-4). The hydraulic conductivity of Hanford and Cold Creek sediments are generally higher than that of Ringold Formation Unit A. Where these stratigraphic units are found in vertical sequence, groundwater is expected to flow preferentially in the Hanford formation or CCU versus the underlying Ringold Formation Unit A.

- Currently, the potential for continued migration of residual constituents from the vadose zone to groundwater is unlikely due to the cessation of liquid effluent discharges to the 216-A-29 Ditch, as well as the lack of any water lines or other direct sources of recharge. Infiltration of natural precipitation is the only potential force capable of moving the remaining contaminants to the groundwater. The current mean annual precipitation rate is 16 cm (6.3 in.), with most annual accumulation occurring between November and February (PNL-10285). Recharge in the 216-A-29 Ditch area is estimated to be between 10 and 20 mm (0.39 and 0.79 in.) annually (PNL-10285). The range of recharge rates depends on a variety of factors, but the coarse sediments beneath the inlet end of the facility may result in rates closer to 20 mm/year (0.79 in./year). No recent infiltration abatement measures (impermeable material covering), other than revegetation, have been implemented at the 216-A-29 Ditch. The risk of infiltration by snowmelt and the potential for vertical migration of contaminants, however, is considered low because of low annual precipitation.

- In 2014, analysis of sulfate, nitrate, and specific conductance in network monitoring wells located upgradient and downgradient along the 216-A-29 Ditch indicate three distinct flow path and constituent concentration regions (Figure 2-9). With cessation of effluent discharge to the ditch, concentrations of constituents such as nitrate and sulfate from upgradient sources now have the greatest influence on specific conductance levels observed in wells downgradient of the 216-A-29 Ditch. The region with the highest upgradient and downgradient sulfate and associated specific conductance levels is found at the southern end of the ditch. Diffuse migration of low concentration nitrate and sulfate from the northwest to the southeast occurs through the middle portions of the ditch. At the north end of the ditch, where groundwater flow is more directed to the south, levels of nitrate, sulfate, and specific conductance are higher in the downgradient region compared to upgradient. In this downgradient area, as indicated by Well 299-E25-32P, concentrations of nitrate, sulfate and specific conductance have all shown a sharp change in trend, with levels increasing near the beginning of 2012 (Figure 2-8).

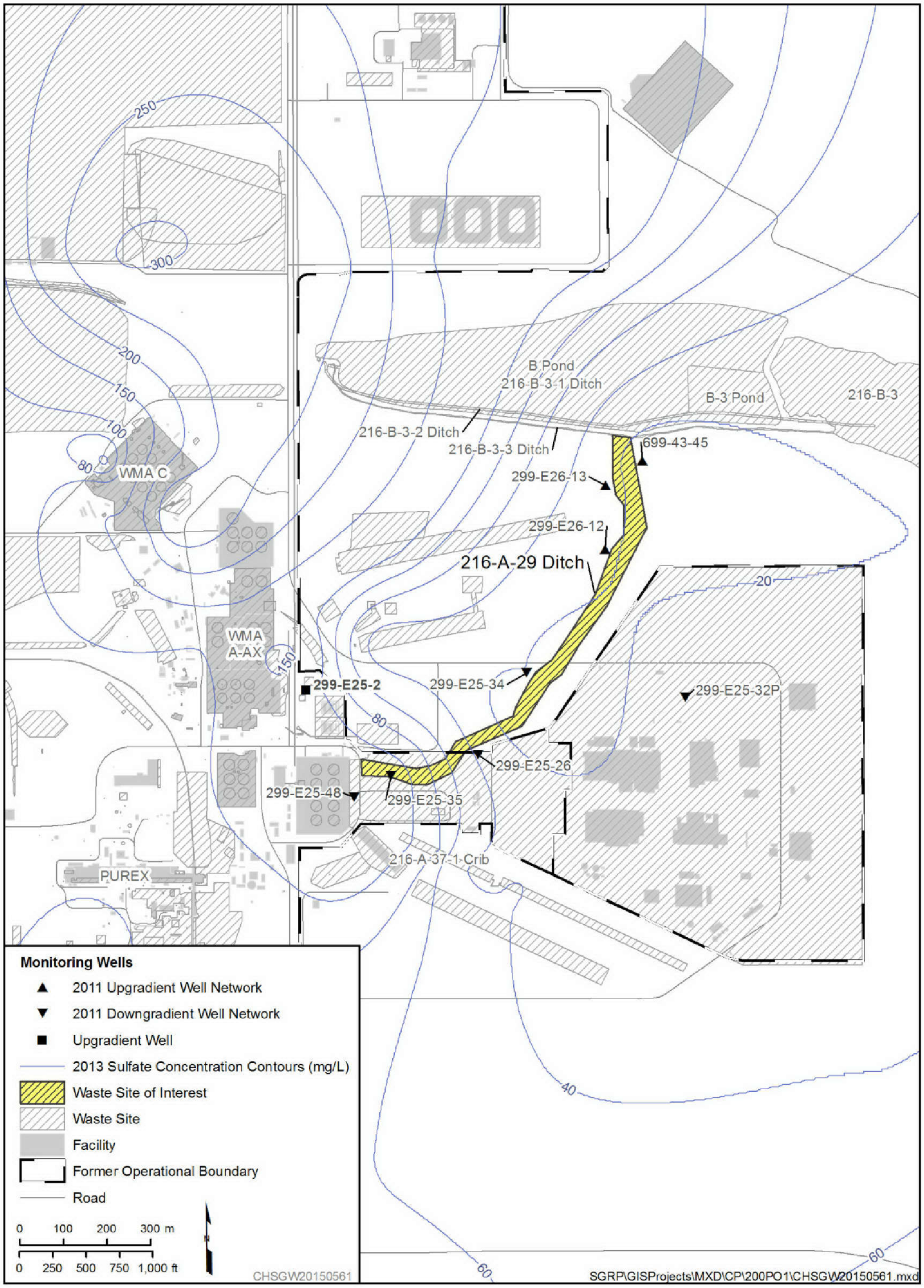


Figure 2-7. Contour Map of 2013 Sulfate Concentrations in the Vicinity of the 216-A-29 Ditch

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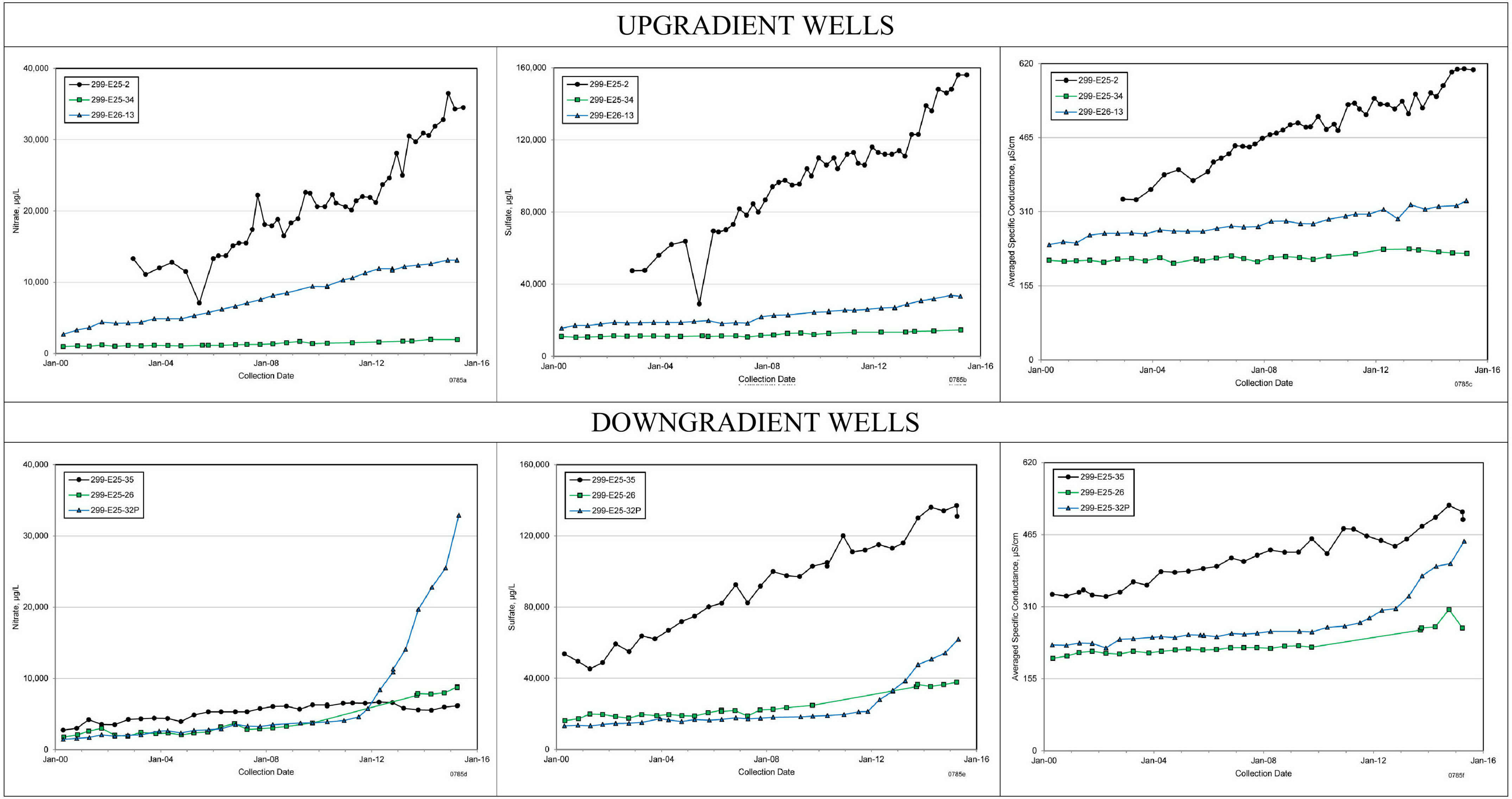

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2 **Figure 2-8. Time Series Plot Showing Nitrate, Sulfate, and Specific Conductance Concentration Trends in This Plan's Upgradient and Downgradient Wells**

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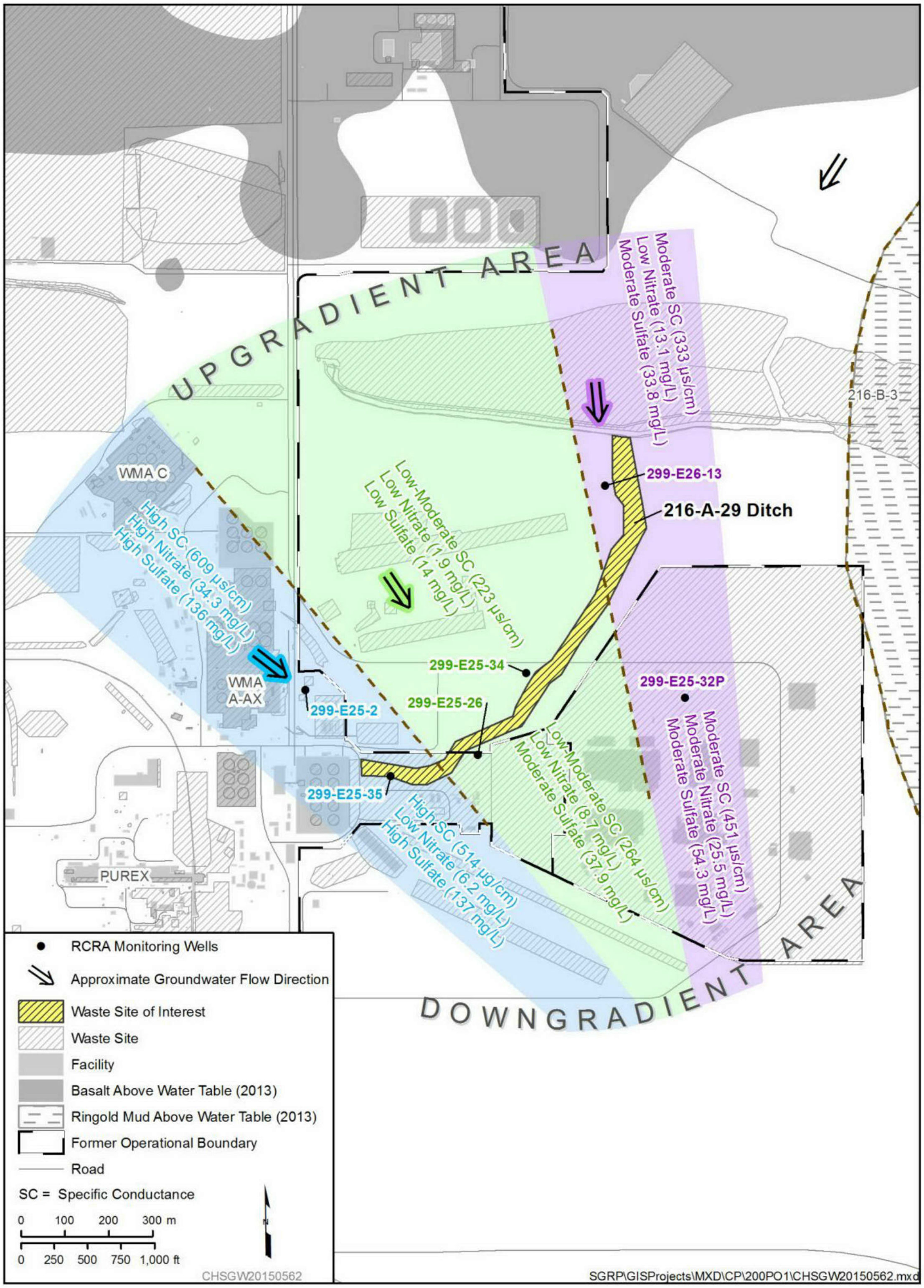

Figure 2-9. Conceptual Site Model for the 216-A-29 Ditch

2.7 Monitoring Objectives

The groundwater monitoring program at the 216-A-29 Ditch is conducted with the objectives of providing a program capable of determining the facility's impact, if any, on the quality of the underlying groundwater, and complying with applicable RCRA requirements for interim status TSD units where no impact to groundwater has been identified. Regulatory requirements applicable to this groundwater monitoring plan are found in WAC 173-303-400(3) and 40 CFR 265.90, "Applicability," through 265.94, "Recordkeeping and Reporting." Table 2-3 identifies where each groundwater monitoring element of the pertinent applicable regulations is addressed within this plan.

Site-specific constituents (Table 2-4) will also be collected for general groundwater chemistry, which will support the evaluation of upgradient and downgradient water chemistry variations (e.g., data used for Stiff diagrams and charge balance determinations). Field parameters will be collected to provide information on water properties at the time of sampling.

Table 2-3. Pertinent RCRA Interim Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement[a]	Section Where Requirement is Addressed in Monitoring Plan
Number and Location of Wells	40 CFR 265.91, "Ground-Water Monitoring System": (a) A ground-water monitoring system must be capable of yielding ground-water samples for analysis and must consist of: (1) Monitoring wells (at least one) installed hydraulically upgradient (i.e., in the direction of increasing static head) from the limit of the waste management area. Their number, locations, and depths must be sufficient to yield ground-water samples that are: (i) Representative of background ground-water quality in the uppermost aquifer near the facility; and (ii) Not affected by the facility; and (2) Monitoring wells (at least three) installed hydraulically downgradient (i.e., in the direction of decreasing static head) at the limit of the waste management area. Their numbers, locations, and depths must ensure that they immediately detect any statistically significant amounts of dangerous waste or dangerous waste constituents that migrate from the waste management area to the uppermost aquifer.	Section 3.2
Well Configuration	40 CFR 265.91: (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. This casing must be screened or perforated, and packed with gravel or sand, where necessary, to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space (i.e., the space between the bore hole and well casing) above the sampling depth must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the ground water. Additional requirements from WAC 173-303-400(3)(c)(v)(C), "Dangerous Waste Regulations," "Interim Status Facility Standards":	Section 3.2 and Appendix C

Table 2-3. Pertinent RCRA Interim Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement[a]	Section Where Requirement is Addressed in Monitoring Plan
	Ground water monitoring wells must be designed, constructed, and operated so as to prevent ground water contamination. Chapter 173-160 WAC may be used as guidance in the installation of wells.	
Parameters to be Sampled Frequency of Sampling Water Level Measurements	40 CFR 265.92, "Sampling and Analysis": (b) The owner or operator must determine the concentration or value of the following parameters in ground-water samples in accordance with paragraphs (c) and (d) of this section: (1) Parameters characterizing the suitability of the ground water as a drinking water supply, as specified in Appendix III[b]. (2) Parameters establishing ground-water quality: (i) Chloride (ii) Iron (iii) Manganese (iv) Phenols (v) Sodium (vi) Sulfate [Comment: These parameters are to be used as a basis for comparison in the event a ground-water quality assessment is required under §265.93(d).] (3) Parameters used as indicators of ground-water contamination: (i) pH (ii) Specific conductance (iii) Total organic carbon (iv) Total organic halogen (c)(1) For all monitoring wells, the owner or operator must establish initial background concentrations or values of all parameters specified in paragraph (b) of this section. He must do this quarterly for one year. (2) For each of the indicator parameters specified in paragraph (b)(3) of this section, at least four replicate measurements must be obtained for each sample and the initial background arithmetic mean and variance must be determined by pooling the replicate measurements for the respective parameter concentrations or values in samples obtained from upgradient wells during the first year. (d) After the first year, all monitoring wells must be sampled and the samples analyzed with the following frequencies: (1) Samples collected to establish ground-water quality must be obtained and analyzed for the parameters specified in paragraph (b)(2) of this section at least annually.	Section 3.1 and Appendix B, Section B2.2

Table 2-3. Pertinent RCRA Interim Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement[a]	Section Where Requirement is Addressed in Monitoring Plan
	(2) Samples collected to indicate ground-water contamination must be obtained and analyzed for the parameters specified in paragraph (b)(3) of this section at least semi-annually. (e) Elevation of the ground-water surface at each monitoring well must be determined each time a sample is obtained.	
Methods Used to Evaluate the Collected Data and Responses	40 CFR 265.93, "Preparation, Evaluation, and Response": (b) For each indicator parameter specified in §265.92(b)(3), the owner or operator must calculate the arithmetic mean and variance, based on at least four replicate measurements on each sample, for each well monitored in accordance with §265.92(d)(2), and compare these results with its initial background arithmetic mean. The comparison must consider individually each of the wells in the monitoring system, and must use the Student's t-test at the 0.01 level of significance (see appendix IV) to determine statistically significant increases (and decreases, in the case of pH) over initial background. (c)(2) If the comparison for downgradient wells made under paragraph (b) of this section show a significant increase (or pH decrease), the owner or operator must then immediately obtain additional ground-water samples from those downgradient wells where a significant difference was detected, split the samples in two, and obtain analyses of all additional samples to determine whether the significant difference was a result of laboratory error. (d)(1) If the analyses performed under paragraph (c)(2) of this section confirm the significant increase (or pH decrease), the owner or operator must provide written notice to the department-within seven days of the date of such confirmation-that the facility may be affecting ground-water quality. (d)(2) Within 15 days after the notification under paragraph (d)(1) of this section, the owner or operator must develop a specific plan, based on the outline required under paragraph (a) of this section and certified by a qualified geologist or geotechnical engineer, for a ground-water quality assessment at the facility.	Section 4.1, 4.2, 4.3 and Appendix A
Recordkeeping and Reporting	40 CFR 265.94, "Recordkeeping and Reporting": (a)(1) Keep records of the analyses required in §265.92(c) and (d), the associated ground-water surface elevations required in §265.92(b) throughout the active life of the facility. (a)(2) Report the following ground-water monitoring information to the department: (ii) Annually: Concentrations or values of the parameters listed in §265.92(b)(3) for each ground-water monitoring well, along with the required evaluations for these parameters under §265.92(b). The owner or operator must separately identify any significant differences from the	Section 4.5 Appendix A, Sections A2.6

Table 2-3. Pertinent RCRA Interim Status Facility Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement[a]	Section Where Requirement is Addressed in Monitoring Plan
	initial background found in the upgradient wells, in accordance with §265.92(c)(1).	

Note: References cited in this table are included in Chapter 6 of this plan.

a. RCRA regulatory requirements for interim status TSD units, where no impact to groundwater has been identified, are found in WAC 173-303-400(3), "Dangerous Waste Regulations," "Interim Status Facility Standards," and 40 CFR 265.90, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Applicability," through 40 CFR 265.94, "Recordkeeping and Reporting," which are applicable to this groundwater monitoring plan.

b. Parameters characterizing the suitability of the groundwater as a drinking water supply, as specified in 40 CFR 265 (Appendix III) "EPA Interim Primary Drinking Water Standards," are not listed because, in accordance with 40 CFR 265.92(c)(1), "Sampling and Analysis," these analyses are conducted only during the first year of monitoring.

CFR = *Code of Federal Regulations*

RCRA = *Resource Conservation and Recovery Act of 1976*

TSD = treatment, storage, and disposal

Table 2-4. Additional Monitoring Objectives

Monitoring Objective	Site-Specific Constituents
Metals – Additional metals added for charge balance calculations, other than sodium that is already listed as a Groundwater Quality Parameter.	Calcium, magnesium, and potassium
Anions – Additional anion added for charge balance calculations, other than chloride and sulfate that are already listed as Groundwater Quality Parameters.	Nitrate
Alkalinity – Used for charge balance calculations.	Alkalinity
Field parameters – Collected to provide information on water properties at the time of sampling	Field parameters (temperature and turbidity)

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3 Groundwater Monitoring Program

This chapter describes the groundwater monitoring indicator evaluation program for the 216-A-29 Ditch consisting of a monitoring well network, parameters used as indicators of groundwater contamination, parameters establishing groundwater quality, and sampling and analysis protocols. The monitoring program presented herein has been revised from that presented in the previous plan (DOE/RL-2008-58, Rev. 0).

The 216-A-29 Ditch is anticipated to be clean closed through an approved RCRA closure plan (DOE/RL-2008-53). Thus, after final closure, a RCRA groundwater monitoring plan will not be required. However, any past-practice contamination that may remain in the soil or groundwater will be addressed through the CERCLA remedial action process.

3.1 Constituents List and Sampling Frequency

Table 3-1 presents the wells in the groundwater monitoring network, parameters analyzed as required for RCRA monitoring, and sampling frequency for monitoring of the 216-A-29 Ditch. Parameters used as indicators of groundwater contamination (pH, specific conductance, TOC, and TOX) will be sampled and analyzed semiannually (40 CFR 265.92[b][3] and [d][2]), except for the first year for New Well #1 and New Well #2, which will require quarterly sampling and analyses. Parameters establishing groundwater quality (chloride, iron, manganese, phenols, sodium, and sulfate) will be sampled and analyzed annually (40 CFR 265.92[b][2] and [d][1]), except for the first year for New Well #1 and New Well #2, which will require quarterly sampling and analyses. At the end of the first year, monitoring at the two new wells will thereafter be conducted along the same frequency as other established wells and as provided in Table 3-1. Water level measurements at each monitoring well will be determined each time a sample is obtained (40 CFR 265.92[e]).

Although not required by regulation, site-specific constituents are identified in Table 3-1 and will be sampled and analyzed annually, except for the first year for New Well #1 and New Well #2, which will require quarterly sampling and analyses. These site-specific constituents support analysis of general water chemistry in the upgradient and downgradient monitoring areas and allow for charge-balance computations to assess laboratory performance. Though included in the previous plan, oxidation-reduction potential was not included in the updated plan because it is not required under RCRA and was not identified as part of the current monitoring objectives for this site. Analyses of groundwater chemistry to evaluate potential reducing conditions are no longer needed and the single deeper well (299-E25-28) was dropped from the well network.

Maintenance problems and sampling logistics sometime delay scheduled sampling events. Sampling events are scheduled by month. The Field Work Supervisor (FWS) determines the specific times within a given month that a well is sampled. If a well cannot be sampled at the times determined by the FWS, then the FWS and Sampling Management and Reporting group, along with the project scientist, consult on how best to recover or reschedule the sampling event as close to the original sampling date as possible. Missed sampling events that are not rescheduled within the same month are given top priority when rescheduling in the following month. Missed or cancelled sampling events are reported to DOE-RL, at the appropriate Unit Managers Meeting, and in the annual groundwater monitoring report.

3.2 Monitoring Well Network

The revised 216-A-29 Ditch monitoring network presented in this plan consists of three upgradient wells, three existing downgradient wells, and two new downgradient wells. Wells are, or will be, screened (or perforated) in the uppermost part of the unconfined aquifer at the water table. Figure 3-1 shows the groundwater monitoring network. Information on the wells is summarized in Table 3-2.

Adjustments to the monitoring well network from the previous monitoring plan (DOE/RL-2008-58, Rev. 0) include:

- Well 299-E25-34 was previously designated downgradient of the 216-A-29 Ditch but is now upgradient due to changes in groundwater flow direction.
- Wells 299-E25-28, 299-E25-48, and 699-43-45, used in the previous monitoring network, are not utilized in this revised plan. Well 699-43-45 is no longer upgradient based on the current groundwater flow direction (southeast). Well 699-43-45 is part of the 216-B-3 well monitoring network (DOE/RL-2008-59, *Interim Status Groundwater Monitoring Plan for the 216-B-3 Pond*) and will continue to be monitored for the 216-B-3 RCRA TSD in the upcoming revision to the monitoring plan. Downgradient coverage of the southern end of the 216-A-29 Ditch is provided by Well 299-E25-35; therefore, use of additional Well 299-E25-48 is not needed. Well 299-E25-48 is being used as part of the revised 216-A-37-1 monitoring network (DOE/RL-2010-92, *Interim Status Groundwater Monitoring Plan for the 216-A-37-1 PUREX Plant Crib*). Well 299-E25-28, which had previously been utilized to monitor the deeper portion of the unconfined aquifer, is not needed because the adjacent well (299-E25-34) provides monitoring of the upper unconfined aquifer at the water table as required by RCRA.
- Well 299-E26-12, used in the previous plan, is not needed in the revised monitoring network. Use of the adjacent upgradient well (299-E26-13) provides monitoring for the northern portion of the 216-A-29 Ditch.
- Existing Well 299-E25-2 is added to the network to account for upgradient groundwater flow coming from the vicinity of Waste Management Area A-AX (Figure 3-1). Groundwater flow from this upgradient area transports higher concentrations of constituents such as nitrate and sulfate that result in increased specific conductance levels. Upgradient Well 299-E25-2 is considered appropriate for the monitoring objectives but is not compliant with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," as a RCRA resource protection well or equivalent well. Per agreement between DOE and Ecology, RCRA noncompliant wells are identified and placed on the prioritized drilling schedule for replacement consistent with site-wide cleanup priorities as described in Milestone M-024-58, which is contained in the Tri-Party Agreement Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*), as revised. Well 299-E25-2 has been included in this milestone for future replacement.
- Existing Well 299-E25-26 will continue to be used in the 216-A-29 monitoring network. Although it was identified as compliant with WAC 173-160 in the previous plan, the well is constructed with a carbon steel casing and the annular seal is not compliant. Well 299-E25-26 has also been included per Milestone M-024-58 (Ecology et al., 1989b) for future replacement.
- Wells 299-E25-32P, 299-E25-35, and 299-E26-13 were included in the previous network and are utilized in the updated network.
- Two new wells (New Well #1 and New Well #2) will be installed to improve downgradient monitoring coverage for the central and northern portions of the 216-A-29 Ditch.

If a well is within approximately 2 years of going dry, a replacement well will be proposed. All new RCRA wells proposed for installation at the Hanford Site are negotiated annually by Ecology, DOE, and EPA under Tri-Party Agreement (Ecology et al., 1989a) Milestone M-24-00.

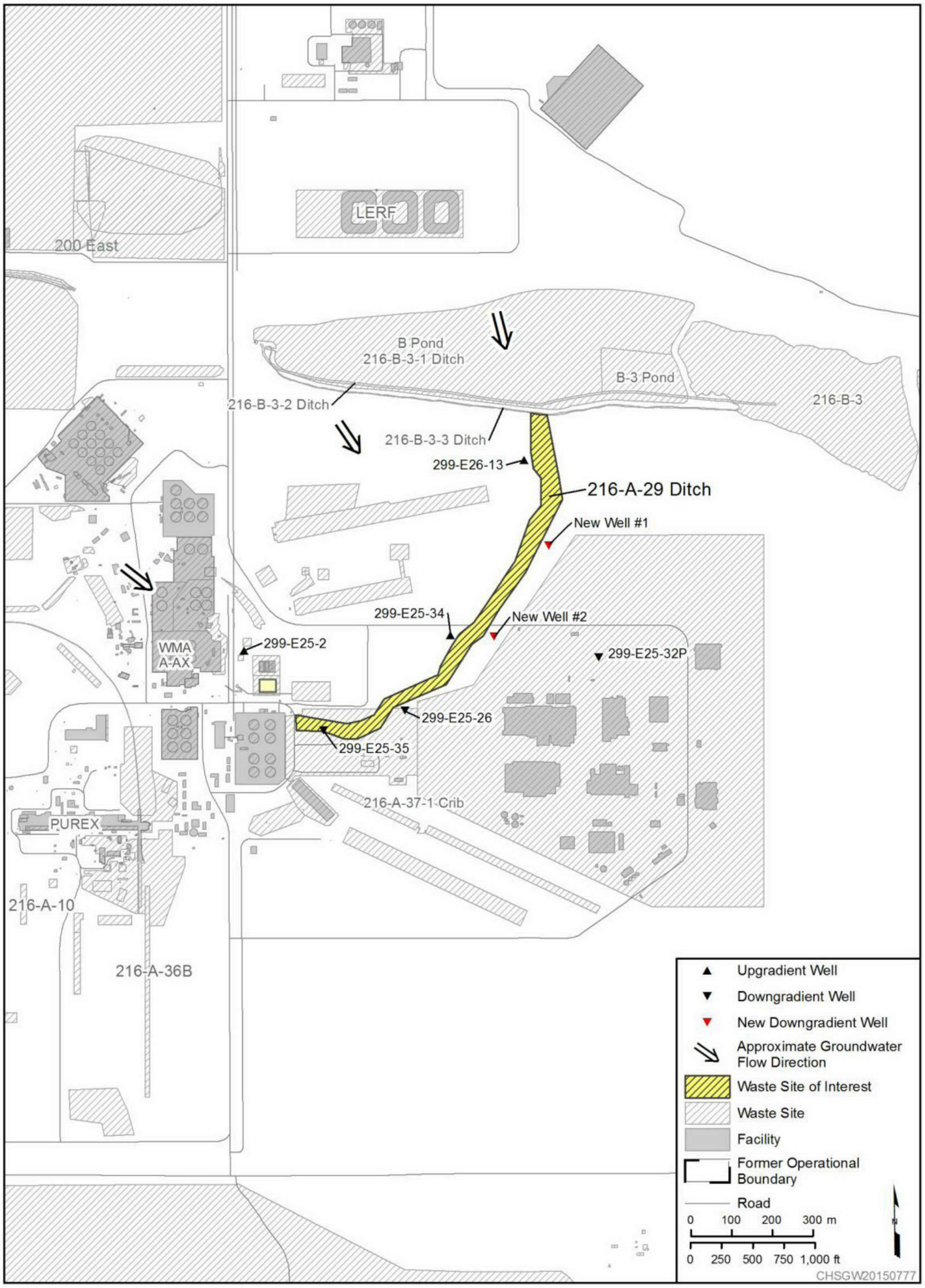

Figure 3-1. 216-A-29 Ditch RCRA Monitoring Network

Table 3-1. Monitoring Well Network for the 216-A-29 Ditch

Well Name	Purpose	WAC Compliant	RCRA Required Parameters[a]											Site-Specific Constituents			
			Water Level	Contamination Indicator Parameters				Groundwater Quality Parameters									
				pH	Specific Conductance	Total Organic Carbon	Total Organic Halogen	Chloride	Iron (Filtered and Unfiltered)	Manganese (Filtered and Unfiltered)	Phenols	Sodium (Filtered and Unfiltered)	Sulfate	Alkalinity	Metals (Filtered and Unfiltered)[b]	Anions[c]	Field Parameters[d]
299-E25-2	Upgradient	N	S	S4	S4	S4	S4	A	A	A	A	A	A	A	A	A	A
299-E25-26	Downgradient	N	S	S4	S4	S4	S4	A	A	A	A	A	A	A	A	A	A
299-E25-32P	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	A	A	A	A
299-E25-34	Upgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	A	A	A	A
299-E25-35	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	A	A	A	A
299-E26-13	Upgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	A	A	A	A
New Well # 1[e]	Downgradient	Y	Q	Q4	Q4	Q4	Q4	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
New Well # 1[f]	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	A	A	A	A
New Well # 2[e]	Downgradient	Y	Q	Q4	Q4	Q4	Q4	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
New Well # 2[f]	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	A	A	A	A

Notes:

a. Parameters required by 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis."

b. Metals (analytes include common soil minerals, calcium, magnesium, and potassium for charge balance computations).

c. Anions (analytes include nitrate for charge balance computations).

d. Field parameters include temperature and turbidity.

e. Constituents and sampling frequency for New Well #1 and New Well #2 only for first year of monitoring.

f. Constituents and sampling frequency for New Well #1 and New Well #2 after first year of monitoring.

A = to be sampled annually
CFR = *Code of Federal Regulations*
N = well is not constructed as a resource protection well (WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells")
Q = quarterly
Q4 = to be sampled quarterly, with quadruplicate samples collected during each event

Table 3-1. Monitoring Well Network for the 216-A-29 Ditch

S	= to be sampled semiannually
S4	= to be sampled semiannually, with quadruplicate samples collected during each event
RCRA	= *Resource Conservation and Recovery Act of 1976*
WAC	= *Washington Administrative Code*
Y	= well is, or will be, constructed as a resource protection well (WAC 173-160)

Table 3-2. Attributes for Wells in 216-A-29 Ditch Groundwater Monitoring Network

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Screen Top (m [ft] bgs)	Screen Bottom (m [ft] bgs)	Water Depth (m [ft] bgs)	Remaining Water Column (m [ft])	Water Level Date
299-E25-2[b]	1955	575513.76	136061.87	84.2 (276)	96.3 (316)	84.7 (278)	11.7 (38.4)	3/3/15
299-E25-26	1985	575907.50	135912.86	82.3 (270)	88.4 (290)	83.2 (273)	5.3 (17.4)	4/1/15
299 E25-32P	1988	576382.42	136044.34	79.1 (260)	85.2 (280)	83.1 (273)	2.1 (6.9)	4/23/15
299 E25-34[b]	1988	576019.04	136100.01	76.7 (252)	82.8 (272)	80.8 (265)	2.1 (6.9)	4/29/15
299 E25-35	1988	575708.34	135864.69	79.4 (260)	85.7 (281)	83.9 (275)	1.8 (6.0)	4/29/15
299 E26-13[b]	1991	576199.30	136528.60	58.5 (192)	64.7 (212)	62.7 (206)	2.1 (6.9)	4/29/15
New Well # 1	TBD	576273.29	136338.56	TBD	TBD	TBD	TBD	NA
New Well # 2	TBD	136094.89	576126.06	TBD	TBD	TBD	TBD	NA

a. Coordinates are in NAD83, *North American Datum of 1983*.
b. Upgradient well.

bgs	= below ground surface
NA	= not applicable
TBD	= to be determined

Construction details and pertinent information for the wells are provided in Appendix C. Some wells are co-sampled with other monitoring programs (e.g., monitored to meet CERCLA requirements). Monitoring requirements for those other monitoring programs are described in separate plans. The reported data from those other monitoring programs are supplementary to information gathered under this plan.

3.3 Differences between This Plan and Previous Plan

Table 3-3 identifies the main differences between this plan and the previous groundwater monitoring plan. Justifications for the differences are provided in the Justification Summary column.

Table 3-3. Main Differences between This Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
Constituents	Indicator parameters, groundwater quality parameters, and water chemistry supporting constituents	Same, except oxidation-reduction potential was eliminated as a site-specific field parameter	Oxidation-reduction potential is not required by RCRA, and it is not a site-specific monitoring objective. Determination of oxidation-reduction potential is not needed for monitoring of the upper unconfined aquifer.
Sampling Frequency	Indicator parameters – semiannual or annual	Indicator parameters – semiannual	Standardized to requirements of RCRA – semiannual in wells used for upgradient-downgradient comparisons.
	Groundwater quality parameters – annual	Groundwater quality – same	No change.
	Water chemistry supporting constituents – semiannual or annual	Water chemistry supporting constituents – annual	Site-specific constituents analyzed annually to correspond with frequency of groundwater quality parameters. Both used for charge-balance calculations.
	Water level measurements – every sampling event	Water level measurements – same	No change.

Table 3-3. Main Differences between This Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
Well Network	Three upgradient wells: 699-43-45 299-E26-13 299-E26-12[b] Six downgradient wells: 299-E25-26 299-E25-28 299-E25-32P 299-E25-34 299-E25-35 299-E25-48	Three upgradient wells 299-E25-2 299-E25-34 299-E26-13 Five downgradient wells: 299-E25-26 299-E25-32P 299-E25-35 New Well #1 New Well #2	Changes in groundwater flow direction have affected utilization of wells relative to upgradient or downgradient designations. Formerly downgradient Well 299-E25-34 is now upgradient. Added existing Well 299-E25-2 to monitor upgradient groundwater that comes from the region of Waste Management Area A-AX and its influence on specific conductance levels downgradient of 216-A-29. Wells 299-E26-12, 699-43-45, and 299-E25-48 were removed from the monitoring network. These wells duplicate information provided from other wells or are not appropriately positioned for the groundwater flow path. Well 299-E25-28, which had previously been utilized to monitor the deeper portion of the unconfined aquifer, is not needed because the adjacent well (299-E25-34) provides monitoring of the upper unconfined aquifer at the water table as required by RCRA. Two new wells will be installed to improve downgradient monitoring coverage for the central and northern portions of the 216-A-29 Ditch.
Groundwater Flow Direction	South or southwest	South-southeast near the north end of the ditch and southeast near the south end of the ditch	Refined flow direction estimates from low-gradient network for different portions of the 216-A-29 Ditch.
Type of Groundwater Monitoring Program	Indicator Evaluation Program	Same	No change.

Table 3-3. Main Differences between This Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
Background Arithmetic Mean Recalculated	Calculated annually using two upgradient wells	Calculated annually using three upgradient wells	Three wells are used to capture spatial variability in upgradient conditions along different segments of the ditch. Calculated annually using EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*.
Groundwater Quality Assessment Plan Outline	None[c]	Chapter 5	Update outline to current norms.

a. DOE/RL-2008-58, Rev. 0, *Interim Status Groundwater Monitoring Plan for the 216-A-29 Ditch*.

b. Well 266-E26-12 was redefined as an upgradient well beginning in 2011 (DOE/RL-2011-118; DOE/RL-2013-22)

c. Previous groundwater quality assessment plan outline provided in PNNL-13047, *Groundwater Monitoring Plan for the 216-A-29 Ditch* (Section 7.0).

3.4 Sampling and Analysis Protocol

The groundwater protection regulations of WAC 173-303-400 dictate groundwater sampling and analysis requirements applicable to interim status TSD units. The QAPjP outlining the project management structure, data generation and acquisition, analytical procedures, and quality control is provided in Appendix A. Appendix B provides the sampling protocols (e.g., sampling methods, sample handling and custody, management of waste, and health and safety considerations).

4 Data Evaluation and Reporting

This chapter discusses the evaluation and interpretation of data.

4.1 Data Review

Data review and verification are discussed in the QAPjP (Appendix A).

4.2 Statistical Evaluation

The goal of the RCRA groundwater monitoring indicator evaluation program is to determine if 216-A-29 Ditch operations have affected groundwater quality beneath the site, which is determined based on the results of specified statistical tests. Under this plan, sampling activities and statistical evaluation methods are based on 40 CFR 265, Subpart F (incorporated by reference into WAC 173-303-400). These interim status regulations require the use of a statistical method that compares mean concentrations of the four general groundwater contamination indicator parameters (pH, specific conductance, TOC, and TOX) to background levels to test for potential impact to groundwater. Each time a monitoring well is sampled, four replicate samples for TOC and TOX are collected, and four replicate field measurements are made for pH and specific conductance.

The basic procedure for statistical comparisons is as follows: twice each year, monitoring data from downgradient wells are compared to the upgradient (background) results for each of the four indicator parameters. The owner or operator must calculate the arithmetic mean and variance, based on at least four replicate measurements on each sample, for each well monitored, and then compare these results with the background arithmetic mean obtained (40 CFR 265.92[c][2]) and updated as discussed in Chapter 5 of EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*. The comparison must consider each of the individual wells in the monitoring system and must use the Student's t-test at the 0.01 level of significance to determine statistically significant increases (and decreases, in the case of pH) over background (40 CFR 265.93[b]). Implementation of the statistical test method at the Hanford Site, including at the 216-A-29 Ditch, is generally consistent with EPA 530/R-09-007. The background statistical analysis is updated annually to establish comparative values for indicator parameters. A rolling mean is used because of changing groundwater flow conditions due to groundwater remedial actions currently being implemented at the Hanford Site.

If a comparison for a downgradient well shows a significant increase (or pH decrease), then the well is resampled. For TOC and TOX, split samples are sent to different laboratories to determine if the exceedance of the comparison value was the result of laboratory error.

If the exceedance of the statistical comparison value is confirmed by resampling, then written notifications are made, as detailed in Section 4.5 and in accordance with 40 CFR 265.

4.3 Interpretation

Data are used to interpret groundwater conditions at the 216-A-29 Ditch. Interpretive techniques include the following:

- **Hydrographs:** Graph water levels versus time to determine decreases and increases and seasonal or manmade fluctuations in groundwater levels.
- **Water table maps:** Use water table elevations from multiple wells to construct contour maps and estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential on the maps.

- **Trend plots:** Graph concentrations of constituents versus time to determine increases, decreases, and fluctuations. May be used in tandem with hydrographs and/or water table maps to determine if concentrations relate to changes in water level or groundwater flow directions.
- **Plume maps:** Map distributions of chemical constituent concentrations in the aquifer to determine the extent of contamination. Changes in plume distribution over time assist in determining plume movement and direction of groundwater flow.
- **Contaminant ratios:** Can sometimes be used to distinguish among different sources of contamination.

4.4 Annual Determination of Monitoring Network

RCRA groundwater monitoring requirements include an annual evaluation of the network to determine if it remains adequate to monitor the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility (40 CFR 265.93[f]). The network must include at least one upgradient and at least three downgradient wells in the uppermost aquifer (40 CFR 265.91[a][1] and [2]).

The current groundwater monitoring network will continue to be re-evaluated to ensure that it is adequate to monitor any changing hydrogeologic conditions beneath the unit. If flow changes are observed, the 216-A-29 Ditch CSM and groundwater constituents will be re-evaluated to determine network efficiency and any necessary modification requirements for the network.

Water level measurements will continue to be collected before each sampling event. An additional and more comprehensive set of water level measurements is made annually for selected wells on the Hanford Site and the data are presented in the annual groundwater monitoring reports.

4.5 Reporting and Notification

Groundwater monitoring results are reported annually in accordance with the requirements of 40 CFR 265.94. Reporting will be made in the annual groundwater monitoring reports.

If a comparison for an upgradient well shows a significant increase (or pH decrease) relative to the statistical comparison value, that information is also reported in the annual groundwater monitoring report.

If the exceedance of the statistical comparison value is confirmed, written notice is then provided to Ecology within 7 days (40 CFR 265.93[d][1]) stating that the facility may be affecting groundwater quality. Within 15 days after the notification, a groundwater quality assessment program must be developed and submitted to Ecology (40 CFR 265.93[d][2] and WAC 173-303-400[3][c][v][D]). In some instances, it is possible to determine immediately that the statistical finding is not the result of contamination from the facility. In that case, Ecology is notified, and a groundwater quality assessment program is not instituted.

5 Outline for Groundwater Quality Assessment Plan

If a groundwater contamination indicator parameter at a downgradient well significantly exceeds the background value or if pH decreases and is confirmed by verification sampling, a detailed assessment plan will be prepared and submitted to Ecology, and the facility monitoring will be elevated to assessment monitoring status. The assessment program must be capable of determining whether dangerous waste or dangerous waste constituents from the facility have entered the groundwater, their rate and extent of migration, and their concentration. This chapter presents a revision of the groundwater quality assessment monitoring plan outline prepared during the first year after the effective date of the regulations, as required by 40 CFR 265.93(a). An outline for the assessment plan is presented in Table 5-1.

The groundwater quality assessment program may include the following elements:

- Description of the hydrogeologic conditions and identification of potential contaminant pathways
- Description of the investigative approach for making first determination to decide if dangerous waste or dangerous waste constituents from the facility have entered the groundwater or if the exceedance was caused by other sources (false positive rationale)
- Description of the approach to fully characterize rate and extent of contaminant migration
- Number, locations, and depths of wells in the monitoring network
- Sampling and analytical methods used
- Data evaluation methods
- An implementation schedule

The results of assessment determinations will be made as soon as technically feasible, and a report of the findings will be sent to Ecology. The determinations will then be updated annually as required by 40 CFR 265.94(b).

Table 5-1. Revised Groundwater Quality Assessment Plan Outline

- Introduction
- Background
    - Facility Description and Operational History
    - Regulatory Basis
    - Waste Characteristics
    - Geology and Hydrogeology
    - Summary of Previous Groundwater Monitoring and Results
    - Conceptual Site Model
    - Monitoring Objectives
- Groundwater Monitoring
    - Constituent List and Sampling Frequency
    - Well Network
    - Water Level Measurements
    - Sampling and Analysis Protocol
- Data Evaluation and Reporting
    - Evaluation of Dangerous Waste Constituents
    - Interpretation
    - Reporting and Notification
    - Corrective Action and Change Control
- References
- Appendix A – Quality Assurance Project Plan
- Appendix B – As-Built Drawings of Wells in Well Network

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Appendix A

Quality Assurance Project Plan

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Contents

Tables

Figures

Terms

AEA	*Atomic Energy Act*
CFR	*Code of Federal Regulations*
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
DQA	data quality assessment
DQI	data quality indicator
EB	equipment blank
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FEAD	format for electronic analytical data
FTB	full trip blank
FWS	Field Work Supervisor
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
IC	ion chromatography
ICP	inductively coupled plasma
ICP-AES	inductively coupled plasma atomic emission spectrometry
LCS	laboratory control sample
MDL	method detection limit
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
PQL	practical quantitation limit
PS	post digestion spike
QA	quality assurance

QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RDR	request for data review
RPD	relative percent difference
SAF	Sampling Authorization Form
S&GRP	Soil and Groundwater Remediation Project
SMR	Sample Management and Reporting
SPLIT	field split
SUR	surrogate
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

A1 Introduction

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the quality assurance (QA) elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). Sections 6.5 and 7.8 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*) require the QA/quality control (QC) and sampling and analysis activities to specify QA requirements for treatment, storage, and disposal (TSD) units, as well as for past practice processes. This QAPjP also describes the applicable requirements and controls based on guidance found in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into the following four sections, which describe the quality requirements and controls applicable to the 216-A-29 Ditch groundwater monitoring activities: Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Review and Usability.

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A2 Project Management

This chapter addresses the management approaches planned, project goals, and planned output documentation.

A2.1 Project/Task Organization

The contractor, or its approved subcontractor, is responsible for planning, coordinating, sampling, and shipping samples to the laboratory. The contractor is also responsible for preparing and maintaining configuration control of the groundwater monitoring plan and assisting the U.S. Department of Energy (DOE)-Richland Operations Office (RL) project manager in obtaining approval of the groundwater monitoring plan and future proposed revisions. The project organization (regarding routine groundwater monitoring) is described in the following subsections and is illustrated in Figure A-1.

A2.1.1 DOE-RL Project Manager

Hanford Site cleanup is the responsibility of DOE-RL. The DOE-RL project manager is responsible for authorizing the contractor to perform activities under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), *Resource Conservation and Recovery Act of 1976* (RCRA), *Atomic Energy Act of 1954* (AEA), and Tri-Party Agreement (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*) for the Hanford Site.

A2.1.2 DOE-RL Technical Lead

The DOE-RL technical lead is responsible for providing day-to-day oversight of the contractor's performance of the work scope, working with the contractor to identify and work through issues, and providing technical input to the DOE-RL project manager.

A2.1.3 Soil and Groundwater Remediation Project Manager

The Soil and Groundwater Remediation Project (S&GRP) manager provides oversight for all activities and coordinates with DOE-RL and primary contractor management in support of sampling and reporting activities. The S&GRP manager also provides support to the S&GRP RCRA groundwater manager to ensure that work is performed safely and cost effectively.

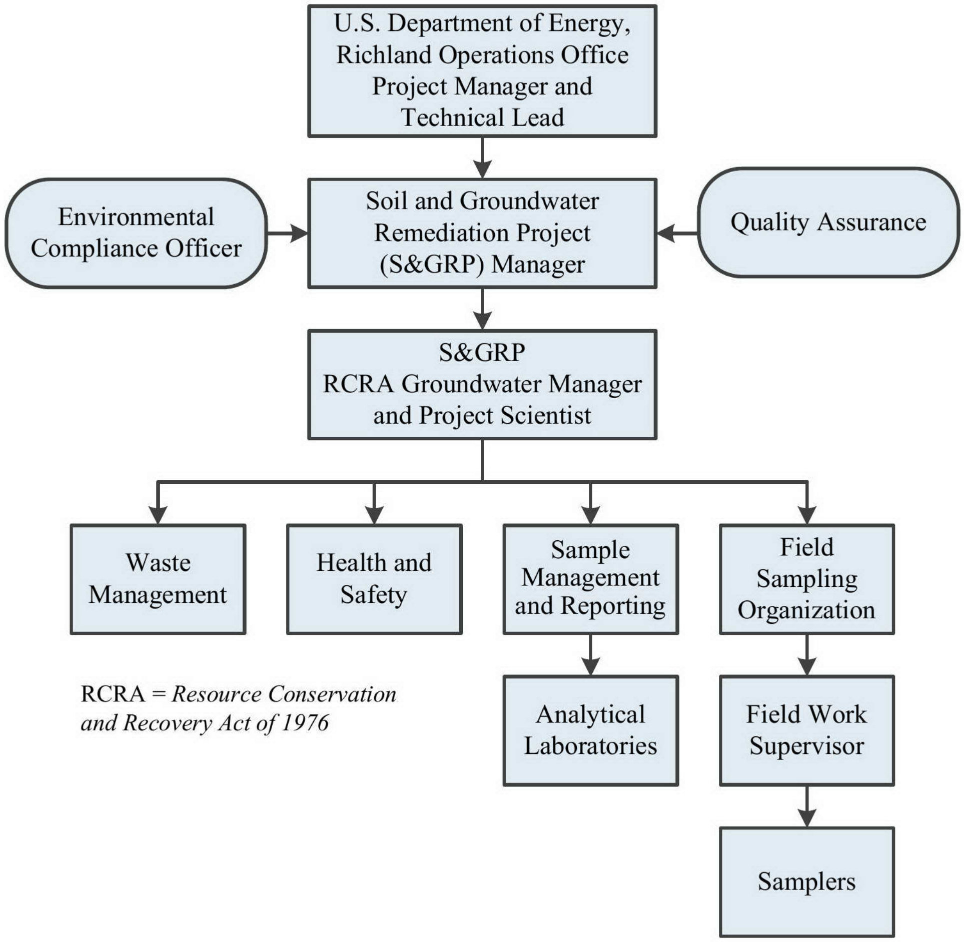

Figure A-1. Project Organization

A2.1.4 S&GRP RCRA Groundwater Manager

The S&GRP RCRA groundwater manager is responsible for direct management of activities performed to meet RCRA TSD monitoring requirements. The S&GRP RCRA groundwater manager coordinates with, and reports to, DOE-RL and primary contractor management regarding RCRA TSD monitoring requirements. The S&GRP RCRA groundwater manager (or delegate) works closely with the Environmental Compliance Officer (ECO), QA, Health and Safety, and Sample Management and Reporting (SMR) group to integrate these and other technical disciplines in planning and implementing the work scope. The S&GRP RCRA groundwater manager assigns scientists to provide technical expertise.

A2.1.5 Sample Management and Reporting Group

The SMR group coordinates laboratory analytical work to ensure that laboratories conform to the requirements of this plan. The SMR group generates field sampling documents, labels, and instructions for field sampling personnel and develops the Sampling Authorization Form (SAF), which provides information and instruction to the analytical laboratories. The SMR group receives analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation. The SMR group is responsible for resolving sample documentation deficiencies or issues associated with the Field Sampling Organization, laboratories, or other entities. The SMR group is responsible for informing the S&GRP RCRA groundwater manager of any issues reported by the analytical laboratories.

A2.1.6 Field Sampling Organization

The Field Sampling Organization is responsible for planning and coordinating field sampling resources and provides the Field Work Supervisor (FWS) for routine groundwater sampling operations. The FWS directs the nuclear chemical operators (samplers), who collect groundwater samples in accordance with this groundwater monitoring plan and in accordance with corresponding standard procedures and work packages. The FWS ensures that samplers are appropriately trained and available. The samplers collect all salient samples in accordance with sampling documentation. The samplers also complete field logbooks and chain-of-custody forms, including any shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

In addition, pre-job briefings are conducted by the Field Sampling Organization, in accordance with work management and work release requirements, to evaluate activities and associated hazards by considering various factors including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required

A2.1.7 Quality Assurance

The QA point of contact is responsible for addressing QA issues on the project and overseeing implementation of the project QA requirements. Responsibilities include reviewing project documents, including the QAPjP, and participating in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.8 Environmental Compliance Officer

The ECO provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts.

A2.1.9 Health and Safety

The Health and Safety organization is responsible for coordinating industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or by internal primary contractor work requirements.

A2.1.10 Waste Management

Waste Management is responsible for identifying waste management sampling/characterization requirements, to ensure regulatory compliance, and interpreting data to determine waste designations and profiles. Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost effective manner.

A2.1.11 Analytical Laboratories

The analytical laboratories analyze samples, in accordance with established procedures and the requirements of this plan, and provide necessary data packages containing analytical and QC results. The laboratories provide explanations of results to support data review and in response to resolution of analytical issues. The laboratories are evaluated under the DOE Consolidated Audit Program and must be accredited by the Washington State Department of Ecology (Ecology) for the analyses performed for S&GRP.

A2.2 Problem Definition/Background

The purpose of this groundwater monitoring plan is to satisfy the requirements of *Washington Administrative Code* (WAC) 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards," and Title 40 *Code of Federal Regulations* (CFR) 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, "Ground-Water Monitoring." Specifics on the activities to satisfy the requirements are provided in the main body of the monitoring plan in Chapter 1.0 and Sections 2.7, 3.1, 3.2, and 4.2. Background information on monitoring is also provided in the main body of this plan in Sections 2.2, 2.5, and 3.3.

A2.3 Project/Task Description

The project description is provided in Chapters 2, 3, and 4 of this monitoring plan and includes the parameter indicators as required by 40 CFR 265.92, "Sampling and Analysis," for establishing groundwater quality and groundwater contamination detection, evaluation of the monitoring network, interpretation of analytical results, and reporting. The parameter indicators to be monitored, along with the monitoring wells and frequency of sampling, are provided in Chapter A3. Information on the collection and analyses of groundwater from the monitoring network is provided in this appendix and in Appendix B. In addition to the required parameter indicators of 40 CFR 265.92, a selection of site-specific constituents to be monitored is included in Chapter A3.

A2.4 Quality Assurance Objectives and Criteria

The QA objective of this plan is to ensure that the generation of analytical data of known and appropriate quality is acceptable and useful in order to meet the evaluation requirements stated in the monitoring plan. In support of this objective, statistics and data descriptors, known as data quality indicators (DQIs), are used to help determine the acceptability and utility of data to the user. The principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. These DQIs are defined for the purposes of this document in Table A-1.

Data quality is defined by the degree of rigor in the acceptance criteria assigned to the DQIs. The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. DQIs are evaluated during the data quality assessment (DQA) process (Section A5.3).

Table A-1. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
Precision	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity) • Request reanalysis or re-measurement • Qualify the data before use
Accuracy	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. Quality control analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use • Request reanalysis or re-measurement
Representativeness	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for them not being representative • Flag for further review • Review data for usability • If data are usable, qualify the data for limited use and define the portion of the system that the data represent • If data are not usable, flag as appropriate • Redefine sampling and measurement requirements and protocols • Resample and reanalyze, as appropriate

Table A-1. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
Comparability	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	If data are not comparable to other data sets: • Identify appropriate changes to data collection and/or analysis methods • Identify quantifiable bias, if applicable • Qualify the data as appropriate • Resample and/or reanalyze if needed • Revise sampling/analysis protocols to ensure future comparability
Completeness	Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/ acceptance criteria).	If data set does not meet completeness objective: • Identify appropriate changes to data collection and/or analysis methods • Identify quantifiable bias, if applicable • Resample and/or reanalyze if needed • Revise sampling/analysis protocols to ensure future completeness

Table A-1. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
Bias	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (MS).	For sampling bias: • Properly select and use sampling tools • Institute correct sampling and subsampling procedures to limit preferential selection or loss of sample media • Use sample handling procedures, including proper sample preservation, that limit the loss or gain of constituents to the sample media • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias • Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as best as practicable; otherwise, samples are sent to other labs for analysis
Sensitivity	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation* is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or re-measurement using methods or analytical conditions that will meet required detection or limit of quantitation • Qualify/reject the data before use

Source: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended.

* For purposes of this groundwater monitoring plan, the lower limit of quantitation is interchangeable with the practical quantitation limit.

DQI = data quality indicator
MS = matrix spike
QA = quality assurance

A2.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility for collecting and transporting groundwater samples according to the dangerous waste training plan maintained for the TSD unit to meet the requirements of WAC 173-303-330, "Personnel Training." The FWS, in coordination with line management, will ensure that special training requirements for field personnel are met.

Training has been instituted by the contractor management team to meet training and qualification programs to satisfy multiple training drivers imposed by the applicable CFR and WAC requirements. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely.

Training records are maintained for each employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management confirms that an employee's training is appropriate and up-to-date prior to performing any fieldwork.

A2.6 Documents and Records

The S&GRP RCRA groundwater manager (or designee) is responsible for ensuring that the current version of the groundwater monitoring plan is used and providing any updates to field personnel. Version control is maintained by the administrative document control process. Table A-2 defines the types of changes that may impact the groundwater monitoring plan and the associated approvals, notifications, and documentation requirements. Changes to elements of the monitoring plan that are required by 40 CFR 265.92 are not allowed, except as unintentional changes as described in Table A-2.

Logbooks and data forms are required for field activities. The logbook must be identified with a unique project name and number. Individuals responsible for the logbooks shall be identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes.

The FWS, SMR, and any field crew supervisors are responsible for ensuring that field instructions are maintained and aligned with any revisions or approved changes to the groundwater monitoring plan. The SMR group will ensure that any deviations from the plan are reflected in revised field sampling documents for the samplers and analytical laboratory. The FWS or appropriate field crew supervisors will ensure that deviations from the plan or problems encountered in the field are documented appropriately (e.g., in the field logbook).

Table A-2. Change Control for Monitoring Plans

Type of Change*	Action	Documentation
Temporary addition of wells or site-specific constituents, or increased sampling frequency that do not impact the requirements of 40 CFR 265.92.	S&GRP RCRA groundwater manager approves temporary change; provides informal notice to Ecology.	SMR group's integrated groundwater monitoring schedule
Unintentional impact to groundwater monitoring plan including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of indicator parameters, and loss of samples in transit.	S&GRP RCRA groundwater manager provides electronic notification to DOE-RL.	Annual groundwater monitoring report
Planned change to groundwater monitoring activities, including addition or deletion of site-specific constituents, change of sampling frequency for site-specific constituents, or changes to well network.	S&GRP RCRA groundwater manager obtains DOE-RL approval; revise monitoring plan.	Revised RCRA groundwater monitoring plan

Table A-2. Change Control for Monitoring Plans

Type of Change*	Action	Documentation
Anticipated unavoidable changes (e.g., dry wells).	S&GRP RCRA groundwater manager provides electronic notification to DOE-RL; revise monitoring plan.	Annual groundwater monitoring report and revised RCRA groundwater monitoring plan

Note: 40 CFR 265.93, "Preparation, Evaluation, and Response," contains additional sampling and notification requirements should indicator parameter results demonstrate a significant increase (or pH decrease).

* Site-specific constituents are any constituents that may be included in this monitoring plan as additional analytes that are not required by 40 CFR 265.92, "Sampling and Analysis."

CFR = *Code of Federal Regulations*

DOE-RL = U.S. Department of Energy, Richland Operations Office

Ecology = Washington State Department of Ecology

RCRA = *Resource Conservation and Recovery Act of 1976*

S&GRP = Soil and Groundwater Remediation Project

SMR = Sample Management and Reporting

The S&GRP RCRA groundwater manager, FWS, or designee is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities. The S&GRP RCRA groundwater manager is also responsible for ensuring that project files are setup, as appropriate, and/or maintained. The project files will contain project records or references to their storage locations. Project files generally include, as appropriate, the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to the SMR group)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Field sampling logbooks
- Groundwater sample reports and field sample reports
- Chain-of-custody forms
- Sample receipt records
- Laboratory data packages
- Analytical data verification and validation reports
- Analytical data "case file purges" (i.e., raw data purged from laboratory files) provided by offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Convenience copies of laboratory analytical results are kept in the HEIS database. Records may be stored in either electronic (e.g., in the managed records area of the Integrated Document Management System) or hard copy format (e.g., DOE Records Holding Area). Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement (Ecology et al., 1989a) will be managed in accordance with the requirements therein.

The results of groundwater monitoring are reported annually in accordance with the requirements of 40 CFR 265.94, "Recordkeeping and Reporting." Reporting will be made in the annual groundwater monitoring reports (e.g., DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*).

A3 Data Generation and Acquisition

This chapter addresses data generation and acquisition to ensure that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. The requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

A3.1 Analytical Method Requirements

Analytical method requirements for samples collected are presented in Table A-3. Updated U.S. Environmental Protection Agency (EPA) methods may be substituted for analytical methods identified in Table A-3.

Table A-3. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (μg/L)
Groundwater Quality Parameters (40 CFR 265.92(b)(2))		
Chloride	EPA/600 Method 300.0	400
Sulfate		550
Iron	SW-846 Method 6010B/C	50
Manganese		5
Sodium		500
Phenols	SW-846 Method 8270D	5
Contamination Indicator Parameters (40 CFR 265.92(b)(3))		
pH	Field measurement Instrument/meter	N/A
Specific Conductance		N/A
Total Organic Carbon	SW-846 Method 9060	1,000
Total Organic Halogen	SW-846 Method 9020	10
Site-Specific Constituents[c]		
Alkalinity	EPA/600 Method 310.1	5,000
Nitrate	EPA/600 Method 300.0	250
Calcium	SW-846 Method 6010B/C	1,000
Magnesium		750
Potassium		4,000
Temperature	Field measurement Instrument/meter	N/A
Turbidity		N/A

Table A-3. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable PQL[b] (µg/L)

Reference: 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis"

Note: The information in this table does not represent EPA requirements but is intended solely as guidance.

a. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*. Equivalent methods may be substituted.

b. Highest allowable practical quantitation limits are specified in contracts with analytical laboratories. Actual quantitation limits vary by laboratory and may be lower than required contractually. Method detection limits are three to five times lower than quantitation limits.

c. Site-specific constituents are not required by RCRA but are used to support interpretation.

CFR = *Code of Federal Regulations*

EPA = U.S. Environmental Protection Agency

N/A = not applicable

PQL = practical quantitation limit

RCRA = Resource *Conservation and Recovery Act of 1976*

A3.2 Field Analytical Methods

Field screening and survey data will be measured in accordance with HASQARD (DOE/RL-96-68) requirements (as applicable). Field analytical methods may also be performed in accordance with manufacturer manuals. Appendix B provides the parameters identified for field measurements.

A3.3 Quality Control

QC requirements specified in the plan must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC sample requirements are summarized in Table A-4. Acceptance criteria for field and laboratory QC are shown in Table A-5. Data will be qualified and flagged in HEIS, as appropriate.

Table A-4. Project Quality Control Requirements

Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Field Duplicates	One in 20 well trips	Precision, including sampling and analytical variability
Field Splits	As needed When needed, the minimum is one for every analytical method, for analyses performed where detection limit and precision and accuracy criteria have been defined in the Analytical Performance Requirements (Table A-3)	Precision, including sampling, analytical, and interlaboratory

Table A-4. Project Quality Control Requirements

Sample Type	Frequency	Characteristics Evaluated
Full Trip Blanks	One in 20 well trips	Cross-contamination from containers or transportation
Equipment Blanks	As needed If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment blank is not required Otherwise, one for every 20 samples[a]	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Analytical Quality Control[b]		
Laboratory Duplicates	1 per analytical batch[c]	Laboratory reproducibility and precision
Matrix Spikes	1 per analytical batch[c]	Matrix effect/laboratory accuracy
Post-Digestion Spike	1 per analytical batch[c]	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	1 per analytical batch[c]	Laboratory accuracy and precision
Laboratory Control Samples	1 per analytical batch[c]	Laboratory accuracy
Method Blanks	1 per analytical batch[c]	Laboratory contamination
Surrogates	1 per analytical batch[c]	Recovery/yield

Note: The information in this table does not represent EPA requirements but is intended solely as guidance.

a. For portable pumps, equipment blanks are collected one for every 10 well trips. Whenever a new type of nondedicated equipment is used, an equipment blank will be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination methods for the nondedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., all Hanford Site groundwater).

c. Unless not required by, or different frequency is called out in, laboratory analysis methods.

EPA = U.S. Environmental Protection Agency

Table A-5. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
General Chemical Analyses			
Alkalinity	MB	< MDL < 5% Sample concentration	Flagged with “C”
	LCS	80–120% recovery	Data reviewed[a]
	Laboratory Duplicate	≤ 20% RPD[b]	Data reviewed[a]

Table A-5. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
	MS	75–125% recovery	Flagged with "N"
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 20% RPD[b]	Flagged with "Q"
Total Organic Carbon	MB	< MDL < 5% Sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[a]
	Laboratory Duplicate or MS/MSD	≤ 20% RPD[b]	Data reviewed[a]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 20% RPD[b]	Flagged with "Q"
Total Organic Halogen	MB	< MDL < 5% Sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[a]
	Laboratory Duplicate or MS/MSD	≤ 20% RPD[b]	Data reviewed[a]
	MS and MSD	75–125% recovery	Flagged with "N"
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 20% RPD[b]	Flagged with "Q"
Anions			
Anions by IC (Chloride Nitrate, and Sulfate)	MB	< MDL < 5% Sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[a]
	Laboratory Duplicate or MS/MSD	≤ 20% RPD[b]	Data reviewed[a]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 20% RPD[b]	Flagged with "Q"

Table A-5. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
Metals			
ICP-AES Metals (Calcium, Iron, Magnesium, Manganese, Potassium, and Sodium)	MB	< RDL < 5% Sample concentration	Flagged with "C"
	LCS	80–120% recovery	Data reviewed[a]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	MS/MSD	≤ 20% RPD[b]	Data reviewed[a]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 20% RPD[b]	Flagged with "Q"
Semivolatile Organic Compounds			
Phenols by GC or GC/MS	MB	< MDL < 5% sample concentration	Flagged with "B"
	LCS	Statistically derived[c]	Data reviewed[a]
	MS and MSD	%Recovery statistically derived[c]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	MS/MSD	%RPD statistically derived[c]	Data reviewed[a]
	SUR	Statistically derived[c]	Data reviewed[a]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 20% RPD[b]	Flagged with "Q"

Notes:

The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, temperature, and turbidity are not listed as they are measured in the field.

a. After review, corrective actions are determined on a case-by-case basis.

b. Applies only in cases where both results are greater than 5 times the method detection limit.

c. Determined by the laboratory based on historical data or statistically derived control limits. Limits are reported with the data. Where specific acceptance criteria are listed, those acceptance criteria may be used in place of statistically derived acceptance criteria.

EB = equipment blank
EPA = U.S. Environmental Protection Agency
FEAD = format for electronic analytical data
FTB = full trip blank
GC = gas chromatography
GC/MS = gas chromatography/mass spectrometry
IC = ion chromatography
ICP-AES = inductively coupled plasma atomic emission spectrometry
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
PS = post-digestion spike
QC = quality control
RDL = required detection limit
RPD = relative percent difference
SUR = surrogate

Table A-5. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
Data Flags			
B (organics) = analyte was detected in both the associated QC blank and the sample) C (inorganics/wetchem) = analyte was detected in both the sample and the associated QC blank and the blank value exceeds 5% of the measured concentration present in the associated sample.		N = all except GC/MS – matrix spike outlier T = volatile organic analysis and semivolatile organic analysis GC/MS – matrix spike outlier Q = associated QC sample is out of limits	

A3.3.1 Field Quality Control Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and two types of field blanks (full trip blanks [FTBs] and equipment blanks [EBs]). Field blanks are typically prepared using high-purity reagent water. QC sample definitions and their required frequency for collection are described in this section:

Field Duplicates: independent samples collected as close as possible to the same time and same location as the scheduled sample, and are intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.

Field Splits: two samples collected as close as possible to the same time and same location and are intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.

Full Trip Blanks: bottles prepared by the sampling team prior to traveling to the sampling site. The preserved bottle set is either for volatile organic analysis only or identical to the set that will be collected in the field. It is filled with high-purity reagent water, and the bottles are sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential contamination of the samples attributable to the sample bottles, preservative, handling, storage, and transportation. `

Equipment Blanks: reagent water passed through or poured over the decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the SAF. EB sample bottles are placed in the same storage containers with the samples from the associated sampling event. EB samples will be analyzed for the same constituents as the samples from the associated sampling event. EBs are used to evaluate the effectiveness of the decontamination process. EBs are not required for disposable sampling equipment.

A3.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by the laboratories utilized by the project. Laboratory QA includes a comprehensive QC program that includes the use of matrix spikes (MSs), matrix duplicates, matrix spike duplicates (MSDs), laboratory control samples (LCSs), surrogates (SURs), post-digestion spikes (PSs), and method blanks (MBs). These QC analyses are required by EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final*

Update IV-B, as amended), and will be run at the frequency specified in the respective references unless superseded by agreement. QC checks outside of control limits are documented in analytical laboratory reports during DQAs, if performed. Laboratory QC and their typical frequencies are listed in Table A-4. Acceptance criteria are shown in Table A-5. The following text describes the various laboratory QC samples:

Laboratory Duplicate: an intralaboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.

Matrix Spike: an aliquot of a sample spiked with a known concentration of target analyte(s). MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.

Matrix Spike Duplicate: a replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.

Post-Digestion Spike: the same as MS; however, the spiking occurs after sample preparation and before analysis.

Laboratory Control Sample: a control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material that is used to evaluate laboratory accuracy.

Method Blank: an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample preparations and analytical procedure and is used to quantify contamination resulting from the analytical process.

Surrogate: a compound added to all samples in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined, yet are not normally encountered. SURs are expected to respond to the preparation and measurement systems in a manner similar to the analytes of interest. Because SURs are added to all standards, samples, and QC samples, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.

Laboratories are required to analyze samples within the holding time specified in Table A-6. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilizing, decomposing, or other chemical changes. Data from samples analyzed outside the holding times are flagged in the HEIS database with an "H."

Table A-6. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses

Constituent/Parameter	Minimum Volume	Container Type[a]	Preservation[b]	Holding Time
Alkalinity	500 mL	Narrow mouth poly or glass	Store ≤ 6°C	14 days
Total Organic Carbon	250 mL	Narrow mouth amber glass with Teflon®-lined lid	Store ≤ 6°C, Adjust pH to < 2 with H_2SO_4 or HCl	28 days
Total Organic Halogen	1 L	Narrow mouth glass with Teflon®-lined lid	Store ≤ 6°C, Adjust pH to < 2 with H_2SO_4	28 days

Table A-6. Preservation, Container, and Holding Time Guidelines for Laboratory Analyses

Constituent/Parameter	Minimum Volume	Container Type[a]	Preservation[b]	Holding Time
Anions by IC (Chloride, Nitrate, and Sulfate)	60 mL	Narrow mouth poly or glass	Store ≤ 6°C	48 hours
ICP Metals (Calcium, Iron, Magnesium, Manganese, Potassium, and Sodium)	250 mL	Narrow mouth poly or glass	Adjust pH to < 2 with nitric acid	6 months
Phenols by GC or GC/MS	4 × 1L	Narrow mouth amber glass with Teflon®-lined lid	Store ≤ 6°C	7 days before extraction 40 days after extraction

Note:

Teflon is a registered trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.

The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, temperature, and turbidity are not listed as they are measured in the field.

a. Under the Container heading, the term poly stands for EPA clean polyethylene bottles.

b. For preservation identified as stored at ≤ 6°C, the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

EPA = U.S. Environmental Protection Agency
GC = gas chromatography
GC/MS = gas chromatography/mass spectrometry
H_2SO_4 = sulfuric acid
HCl = hydrochloric acid
IC = ion chromatography
ICP = inductively coupled plasma

A3.4 Measurement Equipment

Each user of the measuring equipment is responsible to ensure that equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the measuring equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with manufacturer specifications and other approved methods.

A3.5 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or should have been evaluated as acceptable and valid in accordance with instrument-specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to ensure minimization of downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with applicable Hanford Site requirements.

A3.6 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Appendix B. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

A3.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with test methods in SW-846 and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

A3.8 Nondirect Measurements

Data obtained from sources, such as computer databases, programs, literature files, and historical databases, will be technically reviewed to the same extent as the data generated as part of any sampling and analysis QA/QC effort. All data used in evaluations will be identified by source.

A3.9 Data Management

The SMR group, in coordination with the S&GRP RCRA groundwater manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with the applicable programmatic requirements governing data management methods.

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR group on a routine basis. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods. This process is used to document analytical errors and establish their resolution with the S&GRP RCRA groundwater manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and records management.

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A4 Assessment and Oversight

Assessment and oversight activities address the effectiveness of project implementation and associated QA/QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

A4.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this plan, project field instructions, the QAPjP, methods, and regulatory requirements. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies resolutions in accordance with the QA program, corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the S&GRP RCRA groundwater manager.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with laboratory QA plans. The contractor oversees offsite analytical laboratories and verifies that laboratories are qualified for performing Hanford Site analytical work.

A4.2 Reports to Management

Management will be made aware of deficiencies identified by self-assessments, corrective actions from ECOs, and findings from QA assessments and surveillances. Issues reported by the laboratories are communicated to the SMR group, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and establish resolution with the S&GRP RCRA groundwater manager.

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A5 Data Review and Usability

This section addresses the QA activities that occur after data collection. Implementation of these activities determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A5.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review includes linking sample numbers to specific sampling locations, reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times, if any, have been met, and reviewing QC data to determine whether analyses have met the data quality requirements specified in this plan.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Field QA/QC results also will be reviewed to ensure that they are usable.

The project scientist, assigned by the S&GRP RCRA groundwater manager, will perform a data review to help determine if observed changes reflect improved/degraded groundwater quality or potential data errors and may result in submittal of a request for data review (RDR) on questionable data. The laboratory may be asked to check calculations or re-analyze the sample, or the well may be resampled. Results of the RDR process are used to flag the data appropriately in the HEIS database and/or to add comments.

A5.2 Data Validation

Data validation activities may be performed at the discretion of the S&GRP RCRA groundwater manager and under the direction of the SMR group. If performed, data validation activities will be based on EPA functional guidelines.

A5.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the DQA is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project data quality needs. For routine groundwater monitoring undertaken through this groundwater monitoring plan, the DQA is captured in QC associated with the annual Hanford Site groundwater report, which evaluates field and laboratory QC and the usability of data. Further DQAs will be performed at the discretion of the S&GRP RCRA groundwater manager and documented in a report overseen by the SMR group.

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A6 References

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=2cd7465519114fb3472b4864a0e3c42b&node=pt40.26.265&rgn=div5.

265.92, "Sampling and Analysis."

265.93, "Preparation, Evaluation, and Response."

265.94, "Recordkeeping and Reporting."

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Appendix B

Sampling Protocol

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Contents

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Terms

CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
FWS	Field Work Supervisor
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
IATA	International Air Transport Association
NTU	nephelometric turbidity unit
RCRA	*Resource Conservation and Recovery Act of 1976*
S&GRP	Soil and Groundwater Remediation Project
SMR	Sampling Management and Reporting

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B1 Introduction

Resource Conservation and Recovery Act of 1976 (RCRA) groundwater monitoring at the Hanford Site has been conducted since the mid 1980's. Hanford Site groundwater sampling methods contain extensive requirements for sampling precautions to be taken, equipment and its use, cleaning and decontamination, records and documentation, and sample collection, management, and control activities. Appendices A and B, together, provide the sampling and analysis essentials (sample collection, sample preservation, chain of custody control, analytical procedures, and field and laboratory quality assurance/quality control) necessary for the groundwater monitoring plan.

This appendix provides more specific elements of the sampling protocols and techniques used for the RCRA groundwater monitoring plan. Chapter 3 of the groundwater monitoring plan identifies the monitoring wells that will be sampled, the constituents to be analyzed for, and the sampling frequency for the groundwater monitoring at the 216-A-29 Ditch.

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B2 Sampling Methods

Sampling methods may include, but are not limited to, the following:

- Field screening measurements
- Groundwater sampling
- Water level measurements

Groundwater samples will be collected according to the current revision of applicable operating methods. Groundwater samples are collected after field measurements of purged groundwater have stabilized:

- pH – two consecutive measurements agree within 0.2 pH units
- Temperature – two consecutive measurements agree within 0.2°C
- Conductivity – two consecutive measurements agree within 10 percent of each other
- Turbidity – less than 5 nephelometric turbidity units (NTUs) prior to sampling (or project scientist's recommendation)

Absent any special requirements from project scientists, wells are purged utilizing the three borehole volume method. Stable field readings are also required as specified above. The default pumping rate is 7.6 to 45.4 L/min (2 to 12 gal/min), depending on the pump although this is not practical at every well. On occasions when the purge volume is extraordinarily large, wells are purged a minimum of 1 hour and then sampled once stable field readings are obtained.

Field measurements (except for turbidity) are obtained through the use of a flow through cell. Groundwater is pumped directly from the well and to the flow through cell. At the beginning of the sample event, field crews attach a clean stainless steel sampling manifold to the riser discharge. The manifold has two valves and two ports: one port is used only for purgewater, and the other is used to supply water to the flow through cell. Probes are inserted into the flow through cell for measurement of pH, temperature, and conductivity. Turbidity is measured by inserting a sample vial into a turbidimeter. The purgewater is then discharged to the purgewater truck.

Once field measurements have stabilized, the hose supplying water to the flow through cell is disconnected and a clean stainless steel drop leg is attached for sampling. The flow rate is reduced during sampling to minimize loss of volatiles, if any, and prevent over filling of bottles. Sample bottles are filled in a sequence designed to minimize loss of volatiles, if any. Filtered samples are collected after the unfiltered samples. For some constituents, like metals, both filtered and unfiltered samples are analyzed. If additional samples require filtration (e.g., at turbidity greater than 5 NTUs), an inline disposable 0.45 µm filter is used.

Typically, three types (i.e., Grundfos, Hydrostar, and submersible electrical pumps) of environmental grade sampling pumps are used for groundwater sampling at Hanford Site monitoring wells. Individual pumps are selected based on the unique characteristics of the well and the sampling requirements. A small number of wells will not support a pumped sample because of yield or the physical characteristics of the well. In these cases, a grab sample may be obtained.

For certain types of samples, preservatives are required. While the preservative may be added to the collection bottles before their use in the field, it is allowable to add the preservative at the sampling vehicle immediately after collection. Samples may require filtering in the field, as noted on the chain-of-custody form.

To ensure sample and data usability, the sampling associated with this plan will be performed according to DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), pertaining to sample collection, collection equipment, and sample handling.

Suggested sample container, preservation, and holding time requirements are specified in Appendix A (Table A-6) for groundwater samples. These requirements are in accordance with the analytical method specified in Appendix A (Table A-3). The final container type and volumes will be identified on the chain-of-custody form. This groundwater monitoring plan defines a "sample" as a filled sample bottle for starting the clock for holding time restrictions.

Holding time is the maximum allowable time period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Required holding times depend on the constituent and are listed in analytical method compilations such as APHA et al., 2012, *Standard Methods for the Examination of Water and Wastewater*, and SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition; Final Update IV-B*. Recommended holding times are also provided in HASQARD (DOE/RL-96-68).

B2.1 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with the sampling equipment decontamination methods. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

B2.2 Water Levels

Each time a sample is obtained, measurement of the groundwater surface elevation at each monitoring well is required by Title 40 *Code of Federal Regulations* (CFR) 265.92(e) "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis." A measurement of depth to water is recorded in each well prior to sampling, using calibrated depth measurement tapes. Two consecutive measurements are taken that agree within 6 mm (0.02 ft); these are recorded along with the date, time, measuring tape number, and other pertinent information. The depth to groundwater is subtracted from the elevation of a reference point (usually the top of casing) to obtain the water level elevation. Tops of casings are known elevation reference points because they have been surveyed to local reference data.

B3 Documentation of Field Activities

Logbooks or data forms are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbook entries will be reviewed by the sampling Field Work Supervisor (FWS), cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

A summary of information to be recorded in logbooks is as follows:

- The day and date, time the task started, weather conditions, and the names, titles, and organizations of personnel performing the task.
- The purpose of the visit to the task area.
- Site activities in specific detail (e.g., maps and drawings) or the forms used to record such information (e.g., soil boring log or well completion log). Details of any field tests that were conducted. Reference any forms that were used, other data records, and the methods followed in conducting the activity.
- Details of any field calibrations and surveys that were conducted. Reference any forms that were used, other data records, and the methods followed in conducting the calibrations and surveys.
- Details of any samples collected and indicate the preparation, if any, of splits, duplicates, matrix spikes, or blanks. Reference the methods followed in sample collection or preparation. List location of sample collected, sample type, all label or tag numbers, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and the analytical request form number pertinent to each sample or sample set. Note the time and the name of the individual to whom custody of samples was transferred.
- The time, equipment type, and serial or identification number, and the methods followed for decontaminations and equipment maintenance performed. Reference the page number(s) of any logbook (if any) where detailed information is recorded.
- Any equipment failures or breakdowns that occurred, with a brief description of repairs or replacements.

B3.1 Corrective Actions and Deviations for Sampling Activities

The Soil and Groundwater Remediation Project (S&GRP) RCRA groundwater manager, FWS, appropriate field crew supervisors, and Sampling Management and Reporting (SMR) personnel must document deviations from protocols, problems pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected because of field conditions.

As appropriate, such deviations or problems will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The S&GRP RCRA groundwater manager, FWS, field crew supervisors, or SMR personnel will be responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

Changes in sample activities that require notification, approval, and documentation will be performed as specified in Appendix A (Table A-2).

B4 Calibration of Field Equipment

Field instrumentation, calibration, and quality assurance checks will be performed as follows:

- Prior to initial use of a field analytical measurement system.
- At the frequency recommended by the manufacturer or methods, or as required by regulations.
- Upon failure to meet specified quality control criteria.
- Daily calibration checks will be performed and documented for each instrument used. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.
- Standards used for calibration will be traceable to a nationally recognized standard agency source or measurement system.

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B5 Sample Handling

Sample handling and transfer will be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date.

A sampling and analytical data tracking database is used to track the samples from the point of collection through the laboratory analysis process.

B5.1 Containers

Samples shall be collected, where and when appropriate, in break-resistant containers. The field sample collection record shall indicate the laboratory lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used in the field, the name of the manufacturer, lot identification, and certification shall be retained for documentation.

Containers shall be capped and stored in an environment which minimizes the possibility of contamination of the sample containers. If contamination of the stored sample containers occurs, corrective actions shall be implemented to prevent reoccurrences. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. Container types and sample amounts/volumes are identified in Appendix A (Table A-6).

B5.2 Container Labeling

Each sample is identified by affixing a standardized label or tag on the container. This label or tag shall contain the sample identification number. The label shall identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis required, and collector's name or initials. Sample labels may be either preprinted or handwritten in indelible or waterproof ink.

B5.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure the maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for custody of the sample changes, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before sample shipment and will transmit the copy to the SMR group within 48 hours of shipping.

The following minimum information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number
- Date and time of collection

- Matrix
- Preservatives
- Chain of possession information (i.e., signatures and printed names of all individuals involved in the transfer of sample custody and storage locations, and dates of receipt and relinquishment)
- Requested analyses (or reference thereto)
- Shipped-to information (i.e., analytical laboratory performing the analysis)

Samplers should note any anomalies with the samples. If anomalies are found, samplers should inform the SMR group so that special direction for analysis may be provided to the laboratory if deemed necessary.

B5.4 Sample Transportation

All packaging and transportation instructions shall be in compliance with applicable transportation regulations and U.S. Department of Energy (DOE) requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "General Information, Regulations, and Definitions," through 49 CFR 177, "Carriage by Public Highway." Carrier specific requirements defined in the International Air Transport Association (IATA) *Dangerous Goods Regulations* (IATA, current edition) shall also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents shall be considered hazardous material in transportation and transported according to DOT/IATA requirements. If the sample material is known or can be identified, then it will be classified, described, packaged, marked, labeled, and shipped according to the specific instructions for that material and appropriate laboratory notifications will be made, if necessary, through the SMR project coordinator.

B6 Management of Waste

Waste materials are generated during sample collection, processing, and subsampling activities. Waste will be managed in accordance with DOE/RL-2004-18, *Waste Control Plan for the 200-PO-1 Groundwater Operable Unit.* For waste designation purposes, the wells listed in Table 3-2 will be surveyed in the Hanford Environmental Information System and the maximum concentration for each analytes within the most recent 5 years evaluated for use in creating a waste profile, if required. Offsite analytical laboratories are responsible for disposal of unused sample quantities. Pursuant to 40 CFR 300.440, "National Oil and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Off-Site Response Actions," approval from the DOE Richland Operations Office is required before returning unused samples or waste from offsite laboratories.

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B7 Health and Safety

DOE established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," and 10 CFR 830, "Nuclear Safety Management," through 10 CFR 835, "Occupational Radiation Protection." The health and safety program defines the chemical, radiological, and physical hazards and specifies the controls and requirements for daily work activities on the overall Hanford Site. Personnel training, control of industrial safety and radiological hazards, personal protective equipment, site control, and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program.

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Appendix C

Well Construction

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Contents

Figures

Tables

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C1 Introduction

This appendix provides the following information for the 216-A-29 Ditch groundwater monitoring wells:

- Well name
- Hydrogeologic unit to be monitored – the portion of the aquifer that is located at the well screen or perforated casing (Table C-1)
- The following sampling interval information, as shown in Table C-2:
  - Elevation at top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between elevations of top and bottom of the screen or perforated interval)

Figures C-1 through C-6 provide the well construction and completion summaries for 299-E25-2, 299-E25-26, 299-E25-32P, 299-E25-34, 299-E25-35, and 299-E26-13.

Table C-1. Hydrogeologic Monitoring Unit Classification Scheme

Unit	Description
TU	**Top of Unconfined.** Screened across the water table or the top of the open interval is within 1.5 m (5 ft) of the water table, and the bottom of the open interval is no more than 10.7 m (35 ft) below the water table.

Table C-2. Sampling Interval Information for Wells within the 216-A-29 Ditch Network

Well or Aquifer Tube Name	Hydrogeologic Unit Monitored	Elevation Top of Open Interval m (ft) NAVD88	Elevation Bottom of Open Interval m (ft) NAVD88	Open Interval Length m (ft)
299-E25-2	TU	122.2 (401.1)	110.1 (361.1)	12.2 (40.0)
299-E25-26	TU	122.5 (401.9)	116.4 (381.9)	6.1 (20.0)
299-E25-32P	TU	125.3 (411.0)	119.3 (391.3)	6.1 (20.0)
299-E25-34	TU	125.7 (412.6)	119.6 (392.3)	6.1 (20.0)
299-E25-35	TU	126.2 (414.0)	119.9 (393.5)	6.3 (20.7)
299-E26-13	TU	126.0 (413.2)	119.7 (392.6)	6.3 (20.6)
New Well #1[a]	TU	TBD	TBD	TBD
New Well #2[a]	TU	TBD	TBD	TBD

Reference: NAVD88, *North American Vertical Datum of 1988*.

a. New well identified for monitoring of the 216-A-29 Ditch as described in Section 3.2.

TU = Top of Unconfined (as described in Table C-1)

WELL CONSTRUCTION AND COMPLETION SUMMARY

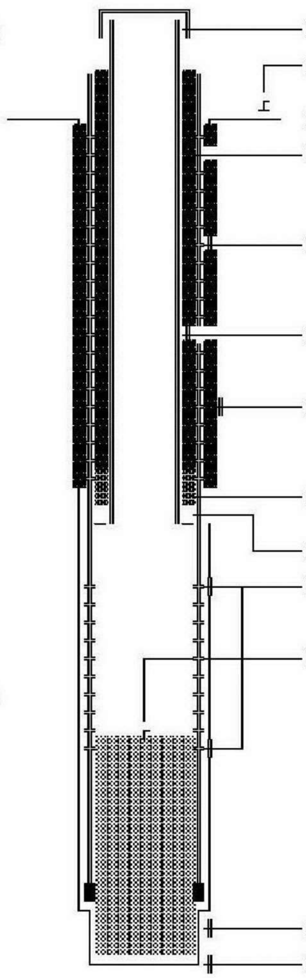
Drilling Method: Cable tool	Sample Method: Hard tool (nom)	WELL NUMBER: 299-E25-2
Drilling Fluid Used: Water	Additives Used: Not documented	TEMPORARY WELL NO: 216-A-1 #6
Driller's Name: Row/Richards	WA State Lic Nr: Not documented	Hanford Coordinates: N/S N 41,265.5 E/W W 47,175.1
Drilling Company: Not documented	Company Location: Not documented	State NAD83 Coordinates: N 136,062.2m E 575,514.0m; N 446,446 E 2,248,044
Date Started: 03Feb54	Date Complete: 15Mar55	Start Card #: Not documented T____ R____ S______
		Elevation Ground surface: 673.6-ft Estimated

Depth to water: 286-ft Mar55
(Ground surface) 271.3-ft 24Jun93

GENERALIZED STRATIGRAPHY Driller's Log

0-10: TOP SOIL and SAND
10-30: Sandy SILT
30-33: SAND and GRAVEL
33-50: Sandy SILT
50-60: SAND, SILT
60-85: Sandy SILT
85-115: SAND, SILT
115-122: GRAVEL
122-135: Sandy SILT
135-205: SAND and SILT
205-210: GRAVEL
210-260: GRAVEL, SAND
260-270: SILT, SAND
270-275: GRAVEL and SILT
275-290: GRAVEL
290-315: GRAVEL and SAND
315-320: SAND
320-330: GRAVEL and SAND
330-335: GRAVEL
335-340: GRAVEL, SAND
340-356: GRAVEL, SAND, SILT
356-365: GRAVEL, SAND, MUD
365-375: BASALT

REMEDIATION:
Jan82, by David Garcia?
Perforated 0-235-ft.
Set 6-in liner to 239-ft.
Poured 10-gals of fine sand, then 18-gals of cement and checked for leaks. Completed with 200-gals of thin grout.



Elevation of reference point: (top of casing) [675.45-ft]
Height of reference point above ground surface [1.9-ft]
Depth of surface seal [0-235-ft]
Type of surface seal: Cement grout between 6-in liner and 8-in (perforated) casing
8-in ID carbon steel casing, +~1-364-ft
Perforated during remediation, 0-235-ft, 2 cuts/ft
6-in ID carbon steel liner, +1.9-ft-240-ft
Hole diameter, 9-in nominal 0-364-ft
Sand plug ~230-240-ft
Packer set: @ 240-ft
8-in casing perforations, 0-235-ft, 2 cuts/ft 276-316-ft, 4 holes/ft
Interval shortened, 14Mar90 Added 14-sacks sand DTB=~316-ft.
Hole diameter, 8-in nominal 364-375-ft
Borehole drilled depth: [375-ft]

Drawing By: RKL/2E25-02.ASB
Date : 03Sep93
Reference : HANFORD WELLS

Figure C-1. Well 299-E25-2 Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

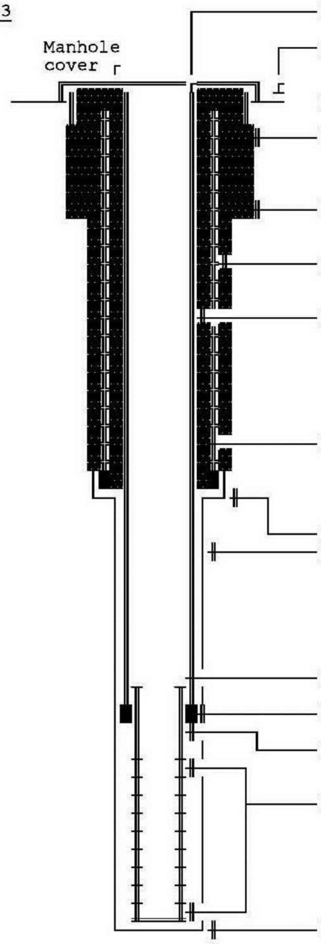
Drilling Method: Cable tool	Sample Method: Hard tool (nom)	WELL NUMBER: 299-E25-26
		TEMPORARY WELL NO:
Drilling Fluid Used: Water	Additives Used: Not documented	Hanford Coordinates: N/S N 40,773 E/W W 45,884
Driller's Name: J. Bultena	WA State Lic Nr: 0066	State Coordinates: N 445,957 E 2,249,336
Drilling Company: Onwego Drilling	Company Location: Kennewick, WA	Start Card #: Not documented T R S
Date Started: 01Mar85	Date Complete: 11Apr85	Elevation Ground surface: 668.51-ft Brass cap

Depth to water: 264-ft Apr85
(Ground surface) 266.1-ft 22Jun93

GENERALIZED STRATIGRAPHY — Geologist's Log

Manhole cover

0-5: Silty SAND
5-10: Gravelly SAND
10-15: Silty SAND
15-20: Gravelly silty SAND
23-40: Gravelly SAND
40-65: SAND
65-75: SAND, SILT lenses
75-100: Gravelly SAND
100-103: SAND
103-105: Silty CLAY, silty SAND
105-110: SAND
110-130: SAND SILT CLAY lenses
130-150: SAND
150-160: Gravelly SAND
160-175: Sandy GRAVEL
175-195: Gravelly SAND
195-205: Sandy GRAVEL
205-240: Sandy GRAVEL, COBBLES
240-245: Sandy GRAVEL
245-255: Silty sandy GRAVEL
255-260: Gravelly silty SAND
260-285: Silty gravelly SAND
285-290: Silty SAND



Elevation of reference point: [668.55-ft] (top of casing)
Height of reference point above ground surface [0.04-ft]
Depth of surface seal [0-20-ft]
Type of surface seal: Cement grout between 8-in and 12-in casing which was partially pulled
Hole diameter, 13-in nominal 0-20-ft
8-in ID carbon steel casing, 0-150-ft, perforated 2 cuts/rd/ft
6-in ID carbon steel casing, 0-264-ft
Annular seal, cement grout between 6-in and perforated 8-in casing, 0-150-ft
Hole diameter, 20-150-ft, 9-in nominal 150-290-ft, 7-in nominal
Packer set, @ 248-ft
6-in casing pulled back from total depth
20-ft blank, 248-269-ft
6-in stainless steel telescoping screen, 269-289-ft, # 20-slot
Borehole drilled depth: [290-ft]

Drawing By: RKL/2E25-26.ASB
Date : 07Sep93
Reference : HANFORD WELLS

Figure C-2. Well 299-E25-26 Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

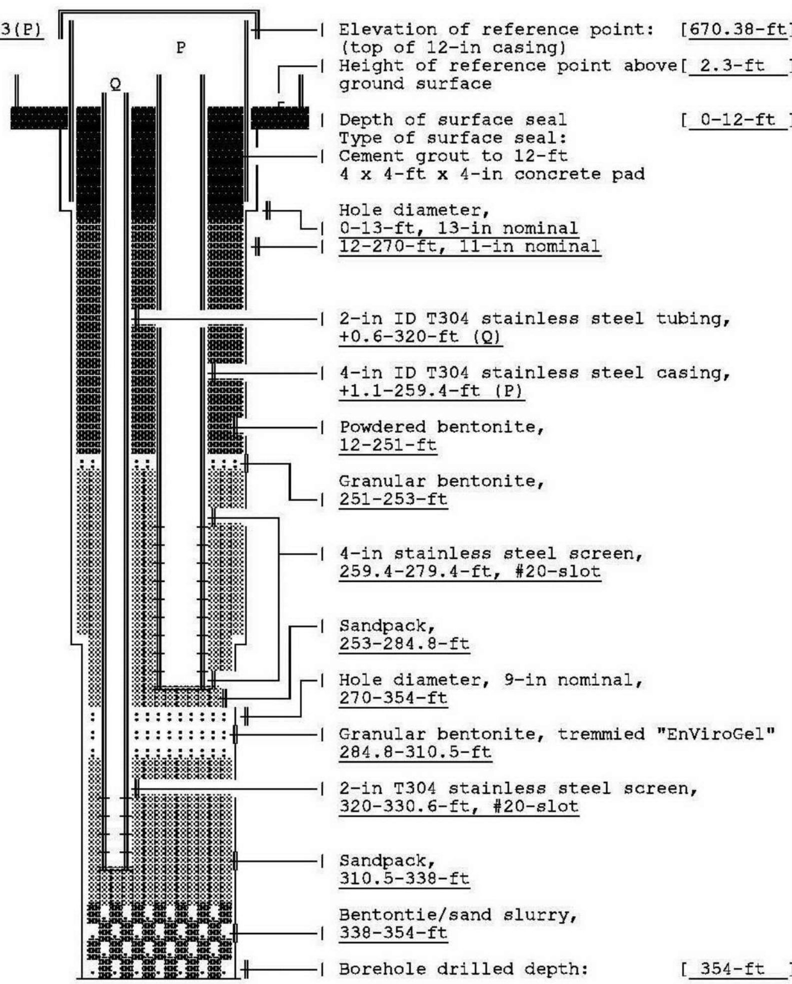
Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E25-32
Drilling Fluid Used: Water	Additives Used: Not documented	TEMPORARY WELL NO:
Driller's Name: O. Amos	WA State Lic Nr: 1224	Hanford Coordinates: N/S N 41,199.2 E/W W 44,325.4
Drilling Company: Kaiser Engineers	Company Location: Hanford	State Coordinates: N 446,387 E 2,250,894
Date Started: 12Nov87	Date Complete: 27Jun88	Start Card #: Not documented T R S
200E Area		Elevation Ground surface: 668.07-ft Brass cap

Depth to water: 264-ft Jun88
(Ground surface) 266.5-ft 22Jun93(P)

GENERALIZED STRATIGRAPHY

Geologist's Log

0-5: Not documented
10-30: Silty gravelly SAND
10-35: SAND
35-45: Silty SAND
45-50: SAND
50-60: Gravelly SAND
60-65: Silty SAND
65-80: SAND
80-90: Silty SAND
90-95: SAND
95-110: Silty SAND
110-140: Silty gravelly SAND
140-145: Silty SAND
145-155: SAND
155-160: Gravelly silty SAND
160-180: Silty sandy GRAVEL
180-185: Sandy GRAVEL
185-235: Silty sandy GRAVEL
235-245: Gravelly silty SAND
245-285: Silty sandy GRAVEL
285-295: Gravelly silty SAND
295-300: GRAVEL
300-305: Sandy GRAVEL
305-350: Silty sandy GRAVEL
350-354: BASALT flowtop



Drawing By: RKL/2E25-32.ASB
Date : 08Sep93
Reference : HANFORD WELLS

Figure C-3. Well 299-E25-32P Construction and Completion Summary

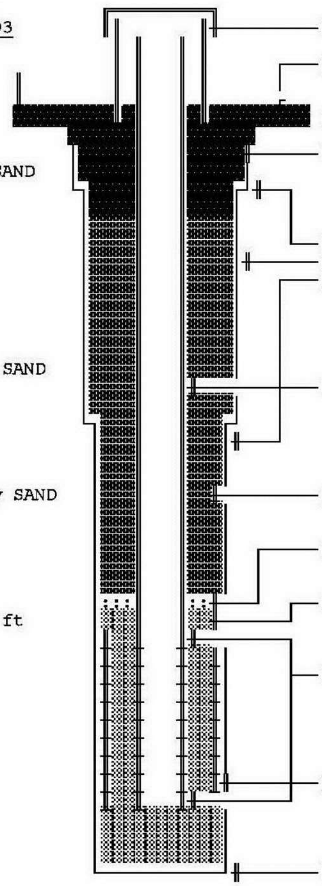
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E25-34 TEMPORARY WELL NO:
Drilling Fluid Used: 200E Area Water	Additives Used: Not documented	Hanford Coordinates: N/S N 41,386 E/W W 45,517
Driller's Name: Cordon/Garcia/Murphy	WA State Lic Nr: 1143 (Garcia)	State Coordinates: N 446,571 E 2,249,702
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: 007916 T 26E R 12N S 1
Date Started: 03Jun88	Date Complete: 19Sep88	Elevation Ground surface: 660.62-ft (Brass cap)

Depth to water: 254.5-ft Sep88
(Ground surface) 258.2-ft 22Jun93

GENERALIZED STRATIGRAPHY   Geologist's Log

0-10: Silty SAND
10-15: Silty sandy GRAVEL
15-20: Slightly silty gravelly SAND
20-30: Slightly gravelly slightly silty SAND
30-35: Slightly gravelly SAND
35-40: Silty SAND
40-55: SAND
55-65: Silty SAND
65-75: SAND
75-80: Gravelly SAND
80-85: Silty sandy GRAVEL
85-90: Gravelly silty SAND
90-100: Slightly silty gravelly SAND
100-105: Slightly gravelly slightly silty SAND
105-110: Gravelly SAND
110-115: SAND
115-120: Slightly gravelly SAND
120-125: Gravelly silty SAND
125-140: Slightly silty gravelly SAND
140-145: SAND
145-150: Slightly gravelly SAND
150-155: Gravelly SAND
155-180: Sandy GRAVEL
180-185: Silty sandy GRAVEL
185-195: Sandy GRAVEL
195-200: Apparent BOULDER @ 195 ft
200-210: Sandy GRAVEL
210-215: Silty sandy GRAVEL
215-225: Sandy GRAVEL
225-230: Gravelly SAND
230-245: Sandy GRAVEL
245-250: Gravelly SAND
250-255: Sandy GRAVEL
255-260: SAND
260-265: Silty sandy GRAVEL
265-270: SAND
270-275: Sandy GRAVEL
275-TD : Gravelly SAND



Drawing By: RKL/2E25-34.ASB
Date : 08Sep93
Reference : HANFORD WELLS

Figure C-4. Well 299-E25-34 Construction and Completion Summary

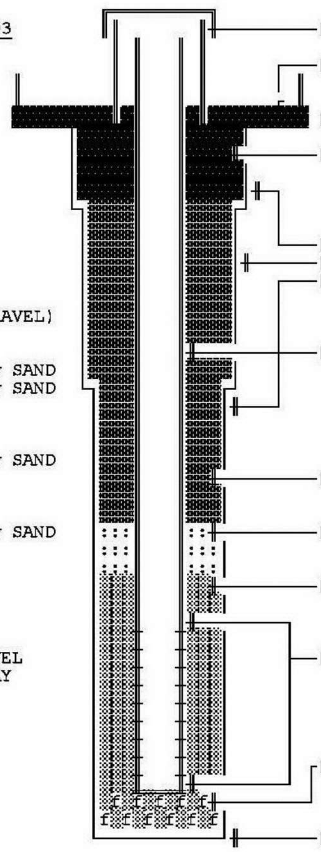
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Not documented	WELL NUMBER: 299-E25-35 TEMPORARY WELL NO:
Drilling Fluid Used: 200E Area Water	Additives Used: Not documented	Hanford Coordinates: N/S N 40,616.7 E/W W 46,538.5
Driller's Name: Amos/Wamsley	WA State Lic Nr: 1224 (Amos)	State Coordinates: N 445,799 E 2,248,682
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T R S
Date Started: 03May88	Date Complete: 27Aug88	Elevation Ground surface: 670.98-ft (Brass cap)

Depth to water: 264.3-ft Aug88
(Ground surface) 268.9-ft 22Jun93

GENERALIZED Geologist's
STRATIGRAPHY Log

0-10: Slightly silty SAND
10-15 Silty SAND
15-20: Sandy GRAVEL
20-30: Silty sandy GRAVEL
30-55: SAND
55-60: Silty gravelly SAND
60-75: Gravelly SAND
75-85: Sandy GRAVEL
85-100: Slightly gravelly SAND
100-115: Gravelly SAND
115-120: SAND (Note: 116-119: GRAVEL)
120-125: Silty SAND
125-130: Gravelly SAND
130-135: Slightly gravelly silty SAND
135-160: Slightly silty gravelly SAND
160-165: Slightly silty SAND
165-170: Slightly silty slightly gravelly SAND
170-175: Slightly silty gravelly SAND
175-185: Silty sandy GRAVEL
185-190: Slightly silty slightly gravelly SAND
190-210: Slightly silty gravelly SAND
210-220: Silty sandy GRAVEL
220-235: Sandy GRAVEL
235-240: Slightly silty SAND
240-245: Silty sandy GRAVEL
245-250: Gravelly SAND
250-255: Silty sandy GRAVEL
255-260: Silty/clayey sandy GRAVEL
260-265: Gravelly sandy SILT/CLAY
265-270: CLAY/SILT
270-275: Slighlty gravelly slightly silty SAND
275-280: Slightly gravelly SAND
280-285: SAND



Elevation of reference point: [674.39-ft]
(top of casing)
Height of reference point above [3.4-ft]
ground surface
Depth of surface seal [3-19.5-ft]
Type of surface seal:
Cement grout 3-19.5-ft
4x4-ft x 4-in concrete pad
extends 3.0-ft into annulus
Hole diameter,
3.0-20.2-ft, 13-in nominal
20.2-145.3-ft, 11-in nominal
145.3-285-ft, 9-in nominal
4-in ID T304 stainless steel casing,
+ND-260.5-ft
Bentonite crumbles,
19.5-250.9-ft
Bentonite pellets,
250.9-256.2-ft
Silica sand pack,
256.2-~281.0-ft, 10-20-mesh
4-in stainless steel screen,
260.5-281.0-ft, #20-slot
Fill,
~281-285.0-ft
Borehole drilled depth: [285.0-ft]

Drawing By: RKL/2E25-35.ASB
Date : 08Sep93
Reference : HANFORD WELLS

Figure C-5. Well 299-E25-35 Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY A4802

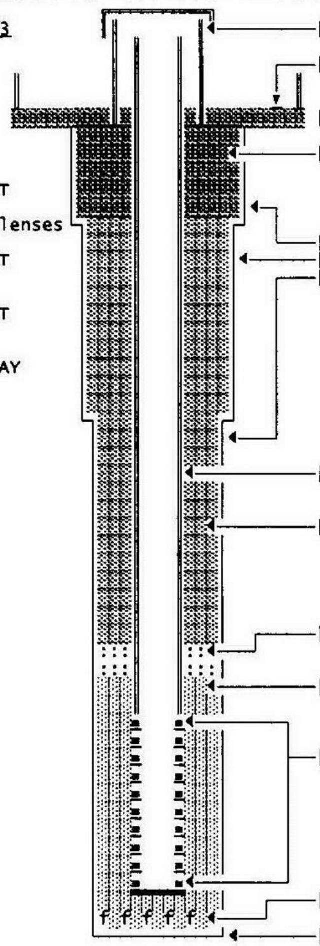
Drilling Method: Cable tool
Sample Method: Drive barrel
Drilling Fluid Used: Raw water
Additives Used: None
Driller's Name: K Blackman/B Smith
WA State Lic Nr: Not documented
Drilling Company: Kaiser Engineers
Company Location: Hanford
Date Started: 03Jun91
Date Complete: 16Aug91

WELL NUMBER: 299-E26-13
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 42,790.3 E/W W 44,922.6
State NAD83 Coordinates: N 136,528.6m E 576,199.3m
N 447,977 E 2,250,293
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 601.57-ft (Brass cap)

Depth to water: 197.0-ft Jun91
(Ground surface) 198.8-ft 22Jun93

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0↔15: Sl silty gravelly SAND
15↔20: Sl silty SAND
20↔25: SAND w/trace SILT
25↔40: Gravelly SAND w/trace SILT
40↔45: Silty SAND w/SILT lenses
45↔45: Silty SAND w/GRAVEL-SILT lenses
45↔50: Silty SAND w/GRAVEL
50↔65: Gravelly SAND w/trace SILT
65↔70: SAND
70↔80: Gravelly SAND
80↔90: Gravelly SAND w/trace SILT
90↔140: Sandy GRAVEL
140↔160: Sandy clayey GRAVEL
160↔170: Sandy GRAVEL w/trace CLAY
170↔205: Sandy clayey GRAVEL
205↔210: Sandy GRAVEL
210↔215: Sandy clayey GRAVEL



Elevation of reference point: [605.02-ft]
(top of casing)
Height of reference point above ground surface [3.47-ft]
Depth of surface seal [2.9↔18.8-ft]
Type of surface seal:
Cement grout, 2.9↔18.8-ft,
4x4-ft x 6-in concrete pad
extends 2.9-ft into annulus
Hole diameter,
2.9↔20.5-ft, 13-in nominal
20.5↔156.3-ft, 11-in nominal
156.3↔215.0-ft, 9-in nominal
4-in ID T304 stainless steel casing,
+1.0↔191.7-ft
Bentonite crumbles,
18.8↔182.2-ft, 8↔20-mesh
½-in bentonite pellets,
182.2↔187.6-ft
Silica sand pack,
187.6↔213.9-ft, 10↔20-mesh
4-in T304 stainless steel screen,
191.7↔212.3-ft, #20-slot
Fill,
213.9↔215.0-ft
Borehole drilled depth: [215.0-ft]

Drawing By: RKL/2E26-13.ASB
Date : 09Sep93
Reference : WHC-SD-EN-DP-047

Figure C-6. Well 299-E26-13 Construction and Completion Summary

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C2 Reference

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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